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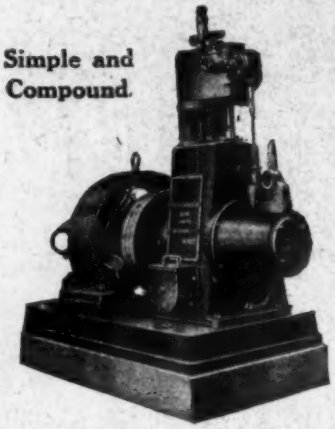

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VOL. LXXXVIII. APRIL 15, 1921. No. 2,264.

ELECTRICAL REVIEW.

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THE MINERS' STRIKE.

As we go to press the position remains uncertain with regard to the prospects of peace and the resumption of work at the collieries, but we believe that the greater catastrophe—a "Triple Alliance" strike—if not completely averted, has at any rate receded from the immediate foreground, and may yet be avoided altogether. We earnestly hope that milder and saner counsels will prevail, for immense injury has already been done by the miners' strike, at a most unfortunate moment—when signs of the long-awaited revival of trade were accumulating, and the nation's hopes of a return of prosperity were gaining strength.

The question at issue is simple enough, and its true significance has been realised by the people of this country. The miners were determined that, come what might, they should retain their privileged position, at the expense of their fellow-citizens, the cost under present conditions being over 1¼ millions sterling every week. Why one section of the community should be subsidised by the rest to the tune of £70,000,000 a year is not apparent; how the miners reconcile their present attitude with their somewhat unctuous protestations of solicitude for the interests of the consumers of coal last autumn is equally obscure—perhaps they have a short memory. They seem to have forgotten, too, that they were issuing a challenge to the British nation, and that the Briton, slow to anger, and quick to forgiveness, is endowed with infinite tenacity when his fighting spirit is aroused. They said in so many words by the mouth of their President: We will ruin the mines by stopping the pumps unless you agree to our demands. That is to say, they demanded surrender as a preliminary to negotiation, and thus left no alternative to any Government worthy of the name but at once to make preparations for dealing with the national emergency.

Not only are some of the pits already permanently ruined; in others, which can be retrieved, the damage done to the electrical apparatus submerged by the rising waters will entail a delay of weeks or months before working can be resumed. Coal-cutting machines, haulage motors, transformers, pump motors, and other electrical apparatus, which play so important and essential a part in coal-getting, were being drowned out. Never before had this senseless course been adopted by the miners, who would not even permit volunteer workers to save their means of livelihood from destruction.

The decision of the Triple Alliance on Wednesday to defer strike action until Friday may be regarded as proof of the existence of differences in their ranks. However that may be, the longer such disastrous action is deferred the brighter are the hopes of settlement being reached. A coal strike is harmful enough not only to production, but also to the foreign trade which is so necessary to our national existence; by a transport strike nothing would be achieved but a further impoverishment of the country, with the added risk of civil turmoil or even a social upheaval which could have but one end—stern repression—and would be utterly disastrous to the future of trade unionism. This country will never tolerate the ascendancy of any revolutionary body, which always means the control of a minority; government by popular suffrage is bred in its bones, and would be defended in case of need with a determination that would sweep away all opposition. For that alone is a guarantee of freedom.

BEAMA Progress.

We publish elsewhere in this issue an account of the work accomplished by the British Electrical and Allied Manufacturers' Association during the year ended December last. The year under consideration was hardly more satisfactory for manufacturers acting in co-operative organisation than for individual concerns. The conditions were difficult enough for everybody, but it may be regarded as a certainty that if the Association had not been hard at work the interests of individual members would have suffered, for there is no room for doubt that if the policy of co-operative action be practised within proper limits, and with reasonable recognition of the merits of elasticity, the well-being of the industry is promoted.

When the "price-adjustment" clause necessitated by the extreme buoyancy of costs of labour and raw materials was found to be an "added discouragement to buyers" who sought elsewhere for firm deliveries and prices, the B.E.A.M.A., after conference with other trade associations, discountenanced its use as from January 1st this year. The members had been some of the worst "involuntary sufferers" under a device "invented elsewhere," and in the interests of the British electrical and allied trades the withdrawal was decided upon. Organisations and private individuals alike are well advised when they profit from experience, and especially so when they are not too tardy in accommodating themselves to the developments in the general situation. Allusion is made in the report to the crushing burden of taxation under which the British manufacturer has been suffering, to the dangers of currency inflation, and to Parliamentary proposals for the regulation of imports, and it is remarked "how these things will work out the present Parliamentary session alone will show," but whatever decisions may be reached at Westminster, we have all got to remember that something cannot be got out of nothing, and in the opinion of the Council we cannot escape from the circumstance that "more strenuous work and higher effective production for lower rewards are the inevitable results of war."

Alterations have been made in the constitution of the Overseas Committees, and the belief is expressed that these committees will be materially strengthened for work in their respective territories. It will be seen, too, that progress has been made in the matter of scholarships to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions, and with the measures for receiving overseas students in British works. As already recorded in our pages, considerable advance has taken place recently in the organisation of electrical research and standardisation. The B.E.A.M.A. Traffic Committee has been busily occupied with the subject of railway rates and classification, and its labours are not yet ended. Negotiations have proceeded with Government departments with regard to their adoption of standard conditions of contract, and in a variety of other ways the Council, its director, its committees, and its large staff have been serving the industries which they represent. It is considered that the satisfactory state of the finances of the organisation is a testimony to members' appreciation of its work. Numerically the membership is practically unaltered at 224, 14 new members having been admitted while 15 have resigned; these resignations were due "in many cases to amalgamation, reconstruction, or dissolution."

Members possess for the present a greater freedom with regard to displays at exhibitions not wholly or mainly electrical, but it has not yet been possible to fix a date for holding a large electrical exhibition under the auspices of the B.E.A.M.A. owing to difficulties in obtaining the necessary space. The customary annual dinner is not to be held this year, as it is felt that it may very well be dispensed with owing to the general situation.

The "Registration" of Contractors.

For a long time past we have had letters from various sources advocating the registration of contractors, in order to protect both the *bona-fide* contractor and the customer from the depredations of the *mala-fide* contractor. In vain have the contractors themselves urged registration, the Board of Trade apparently being unwilling to grant this.

Now, however, from Swansea comes a report of a new development. Contractors in that district, having failed to achieve registration, are about to have it thrust upon them. The local branch of the E.T.U., from purely altruistic motives, intends to issue a list of contractors who have secured its approval. Members of the Corporation referred to the fact that a "fair wage" clause was inserted in all municipal contracts; the Union, however, gave as its reason a desire to protect customers from faulty installations and consequent fire risk, therefore it was rather indelicate to mention wages at all.

British Chances in the Canadian Market.

Our Canadian correspondent has lately obtained the views of several Canadian electrical engineers regarding British-made electrical apparatus, such as switchgear, &c. It has been pointed out to him that one of the main objections to the purchase of such is the difficulty of getting spare parts or of having repairs carried out at short notice. The fact that Canada's proximity to the United States places her in a unique position as regards trade which is not occupied by any other part of the Empire, has been referred to on many occasions in these pages. Unquestionably this places Home manufacturers at a decided disadvantage compared with the great country to the south of the Dominion, as anything can be obtained so much quicker by rail from New York, Buffalo, &c., than by boat from England. Our correspondent has suggested in some quarters in Canada that it might be a good thing for some of the smaller British firms (whose interests are interdependent, and who could not afford, individually, to keep an organisation for the purpose in Canada) to combine and establish a central warehouse and repair depot to surmount the handicap referred to above. A case can be mentioned where, after several years of successful operation, certain electrical equipment supplied from England was discarded and American equipment installed instead, solely because it was felt that with the latter repairs, &c., could be handled more expeditiously. The reason is given by the users of the equipment.

Collapse of the Dutch Supply Monopoly Scheme.

After having been before the country for a period of two years, the scheme for the establishment of a Dutch electricity supply monopoly vested in a semi-State company has been abandoned by the Government, the Minister for Public Works having now withdrawn from the States General the Bill to authorise the execution of the project. Three weeks ago a Dutch news agency reported that the Bill was not to be proceeded with, but it is only now that the newspapers are able to confirm the fact. The proposal to create a monopoly evoked considerable opposition in trading and industrial circles, and among those local authorities who own supply works and who perceived in the monopoly scheme a proposal to expropriate their rights without the prospect of any benefit being conferred upon the general community. In the Second Chamber of the States General the Bill was also opposed, and as a result of a resolution which was adopted by the Chamber the Minister for Public Works is said to have reached the conclusion that it would be advisable to drop the Bill; this, as already mentioned, has now been done.

I.E.E. Nominations.

In our last issue we gave a list of the nominations of the Council of the Institution of Electrical Engineers to fill the vacancies that will occur next September, from which it will be seen that Mr. J. S. Highfield will occupy the presidential chair. The choice was almost a foregone conclusion, for Mr. Highfield has long been on the "short list" for that honourable position, and in tendering him our congratulations on his receiving the highest distinction in the power of the electrical industry to confer, we venture to add that his election also does honour to the Institution and the manifold interests for which it stands. That he will fill the presidential chair with 100 per cent. efficiency goes without saying, and we trust that his year of office will witness the return of prosperity to this country and the cessation of those disputes which have so long harassed our industries.

The new vice-presidents are Prof. E. W. Marchant and Mr. C. C. Paterson, O.B.E., to whom also we extend our congratulations on their well-earned honours.

So far no nominations for Ordinary Members from outside the Council have been announced, and we do not anticipate that any will be made. The Council, as the result of successive reforms both in constitution and procedure, is so thoroughly representative of the membership in all branches of the industry that few will be disposed to find fault with its personnel. In this respect, as in others, the Institution has advanced far beyond the sister Institutions, and the effect of its progressive policy is reflected in its huge membership and growing influence.

Fire Prevention.

A timely communication elsewhere in this issue draws attention to the attitude of the Fire Offices Committee towards the adoption of fire preventive devices by their clients. The complaint against the Committee is that, in spite of the unquestioned efficiency of such devices in giving warning of incipient fires, the rebate allowed on the normal premium is absurdly inadequate in comparison with the enormous advantage accruing to the insurance companies.

This is obviously a most short-sighted policy on the part of the fire offices, whose interests undoubtedly lie in the direction of fire prevention; and it involves a heavy burden on the owners of insured premises, tending to deter them from installing protective devices. In the case of sprinklers, it is true, a liberal reduction is made, of the order of 60 per cent.; but electric alarms are recognised only to the meagre extent of 12½ per cent., regardless of the fact that the very essence of successful fire-prevention is tackling the fire *at the earliest possible moment*; many cases are on record where the outbreak has been notified to the fire brigade station by the alarm, and in due course extinguished before any appreciable damage had occurred, whereas the sprinkler cannot act until the fire has gained headway, and when it does act, it is bound to cause heavy damage by water to the goods in store and to the building.

There is, however, another aspect of the matter which should be kept in view—the national aspect. It is easy to dismiss a fire with the remark that the insurance companies will pay for it, but that is not the sum of the matter; every fire which does damage to property constitutes a dead loss to the nation, whose visible assets are thereby reduced, and the reimbursement of the owner by the fire office in no way affects that fact. The State, therefore, has a right to intervene in the direction of preventing fires *ab initio*, and would be justified in exercising control over the rates of premium if it could be shown that the existing rates deterred the adoption of automatic alarms or resulted in excessive profits to the insurance companies. We therefore cordially support the view that these rates should be reviewed by an impartial authority, which should also take into consideration the extent to which the risk of fire is diminished by the use of electricity for lighting and power.

Domestic Electricity Supply.

The difficulty which many supply station engineers are experiencing in connecting new consumers, for want of plant, &c., can only be overcome by removing the obstacle; but that is no reason why they should neglect the opportunities of development which remain open to them. Obviously, where the capacity of the generating plant is fully taken up, attention must be confined to off-peak loads; one of the best of this class, not only in that it helps to improve the load factor and increase the output, but also because of the satisfaction it gives to the consumer, is that provided by the extended use of small electrical apparatus and accessories in the home. The adoption of these appliances is not likely to exercise any appreciable effect on the maximum demand either at the generating station or at the service end, and there is enormous scope for profitable development of this branch of the business. It does not require the slightest increase in the capital outlay of the undertaking—it simply improves the revenue, and as the energy consumed is mostly paid for at lighting rates, it is a most desirable addition to the income.

As we have pointed out more than once, there is nothing like the electric iron for winning the affection and esteem of the housewife. It would be well worth while to make a present of an iron to every suitable consumer—the results obtained would amply justify the small outlay. But this policy would doubtless be somewhat too progressive for a municipal committee, and the next best thing is to lend an iron on trial; this course very frequently leads to the purchase and permanent employment of this most useful device. Electric kettles, toasters, hot-plates, and fans are also excellent media for the development of the domestic load.

The convenience and comfort derived from the use of such devices can only be realised by trial. Once the "do it electrically" idea has taken root, it needs no cultivation, and the "plant" grows until it may include a suction cleaner, and a washing machine; beyond that stage come the radiator and the cooker, which do not fall within the category of appliances that can be added to a lighting installation without due provision for their supply. But there is abundant scope, as we have said, for development within that limit, and it is up to the central-station manager to educate his consumers in electrical methods.

The French Electrical Industry.

The annual report for 1920 issued by the Union des Syndicats de l'Electricité, of 7, Rue de Madrid, Paris, states that 30,000 workpeople are employed in the French electrical manufacturing industry and 16,000 in the branch of generation and distribution of electricity. In 1913 the capital invested in the former was 307,000,000 fr., which amount has been considerably increased in the meantime. The value of the total production reached 193,000,000 fr., of which 66,000,000 fr. represented electrical machinery and 45,000,000 fr. apparatus; cables, wires, &c., were valued at 40,000,000 fr., batteries, insulators, and carbons at 21,000,000 fr., and lamps at 21,000,000 fr. The electrical industry imported goods to the value of 33,000,000 fr. in 1913, while the exports were worth 34,000,000 fr. The total amount invested in the electrochemical and electrometallurgical industries in 1913 was 480,000,000 fr. The production of aluminium in that year was 13,000 tons, and that of steel in the electric furnace was 20,000 tons, which was increased to 58,000 tons in 1918. It is calculated that the output of cyanamide, which was 7,500 tons in 1913, could now reach 100,000 tons. Concerning the hydro-electric works it is pointed out that a sum of 800,000,000 fr. was employed in this branch in 1913, and the amount had increased to 1,460 millions down to the end of 1919, when about 1,900,000 h.p. was in use our of a total estimate of 9,200,000 h.p.

FUSES FOR SUB-STATIONS.

By A CENTRAL-STATION ENGINEER.

Progress in technical matters takes place broadly in three steps: First, the work is carried out somehow, then it is done well, and finally, it is done well and efficiently. The word efficiency, among other things, denotes commercial efficiency. This has come home to electrical engineers more perhaps than to some other departments of technics, because the electrical men have got into the useful habit of working out costs.

The present shortage of money is fluttering the dovecots and making many people wonder if we have not been unduly extravagant in the past. What with the cost of transformers, of pilot and telephone wires, of expensive protection gear, and of buildings which the bricklayers build a brick at a time, laying them as though loath to part company with their friends, we have come to a time when costs threaten to turn down many schemes which ought not to be turned down. We shall doubtless soon see outside sub-stations without buildings, and with simpler means for protection of the mains.

One thing, that must strike one as extravagant, is the use of oil breakers on the low-pressure distributors. In the old d.c. days, fuses were good enough, but with a.c. supply, oil switches have displaced them to a large extent, with bad results to the financial side. The reason for the change is that, when fed from a large station, a transformer may give an immense amount of current in case of a short circuit near the busbars. A transformer which will give 1,000 amps. at full load, may give 20,000 amps. or more in case of a dead short, and it is the somewhat uncomfortable property of a fuse to be able to pass such hefty currents for a short time, with unpleasant results in many cases. On test, a one-amp. fuse with a 4-in. break was put right across a 550-volt supply, and it arced over, passing probably over 50 amps. of current, a surprising result. All the same, in the present financial situation, we have got to consider the use of fuses in sub-stations, because they are cheap, and it is the object of this article to open up the subject in the hope that others will take the matter up and show how it can be done.

It is evident that fuses for a.c. supply must be designed with some care. Recently I saw a 500-amp. fuse for use in a sub-station, for protecting distributors at 440 volts. It consisted of a substantial porcelain handle of the clip replaceable type, the whole thing being well made. The fuse was made up of six lead wires, in parallel with a copper wire which passed through a tube. The idea was that in case of a fault the lead wires would melt, and the break would be taken by the copper wire. Such doubtless would occur in case of a moderate overload, but it would not happen in case of a really severe fault. In such a case, with the instantaneous passage of, say, 5,000 amperes, the whole mass of the fuse metal would melt together, and under the intense heat, it would explode, and probably blow the porcelain handle to pieces. The explosive power of fuses under such conditions is only understood by those who have had the good fortune to see experiments tried! An inventor brought to one station, which possessed a big battery, a well-made magnetic blow-out fuse. The staff agreed to test it, and, therefore, put it right across the battery, taking the precaution to include a long fuse in the circuit. The test went off so well that the inventor left the fuse behind; in fact, there was nothing left to take away!

In another case, an engineer had a meeting with his directors when loud bangs were heard. "What is that?" asked the chairman in alarm; "have the boilers exploded?" "Oh, they are testing silent fuses," was the answer.

These things are less amusing when they occur in a small sub-station with the attendant near. Indeed, the whole subject of fuses requires research, and no doubt it will get it when we get sufficient sense to work these things out scientifically, instead of by rule of thumb! Enclosed fuses have been placed on the market to overcome the difficulties, and personally, I have not known them to arc over or to explode, but they have other troubles. In one case, a 20-amp. enclosed fuse was put in the pilot wire to a voltmeter. The current was microscopic, but the fuse used to go after a time. In another case, some 500-amp. enclosed fuses were run in an underground box, and one blew. On replacing the blown fuse with a spare, that also blew. On putting in a 250-amp. fuse, it stood without heating. The fact seems to be that the enclosed fuses contain a powder to damp out the arc, and this powder sometimes attacks the fuse wires and causes deterioration.

Enclosed fuses have certain other defects. Engineers always like to see the "innards" of their apparatus, and they also want to inspect them from time to time to see if there is any deterioration. Enclosed fuses won't submit themselves to this ordeal, and it is necessary for the inspector to take their condition on trust. Likewise, they cannot be rewired in the station, but must be replaced by new fuses, a most expensive arrangement if a large number are in use, particularly if they are all renewed once a quarter or even once in six months, as is desirable. One also may be let down if one happens to run out of a particular size at an inconvenient time, by no means an impossible contingency! One must also allow for the possibility of the makers ceasing to supply the pattern most in use, an event which may cause elaborate but vain correspondence between them and the engineer! This side of the question may have painful results.

The January number of the *English Electric Journal* deals at length with the "Zed" enclosed fuse, and it is well worth reading in this connection. The principles of the "Zed" fuse are that a very small quantity of silver wire is used, this being carried by a strong porcelain cylinder. It is claimed that the fuse blows without arcing, and in a safe manner. The writer does not deal with what happens if the circuit is inductive, an important point. The fuses are very short, being only 2½ in. long for 750 volts. They are, however, only made up to 150 amps., and this limits their use for distributor protection, for which purpose 300 amps. is required, even for a distributor of quite small sectional area.

Generally speaking, if makers will supply enclosed fuses which can be opened for inspection, and which can be rewired in the station, there will be a market for them, provided that a guarantee is given that patterns will always be available for replacements in old designs. The fuses should also be of substantial design for use in sub-stations. These demands should not be difficult of fulfilment. Let us hope that the British firms will meet them, and that we shall not be driven to accept patterns supplied from abroad.

A possible pattern of open fuse would consist of a clip, replaceable type, used horizontally, with a horn break. This could be mounted high up, on a slab, and should be reliable and safe. The horns could very well be fitted to the fuse handle, and should not add much to the cost.

Another type of fuse which has been used a good deal is the clip replaceable, with the fuse wires run through the handle. This has stood up to some severe tests, and is promising. The fuse wires should preferably be of small section, several being used in parallel, and it would probably be an advantage if each wire was separated by being run in its own tube. This would help to extinguish the arc after a severe "short," and also to reduce the explosion.

A further design consists of several fuse wires fixed to pillars which separate them from the board. The question of covering the fuses with asbestos stockings is important. The asbestos makes the blowing point somewhat uncertain, as up to a point it may cool the

fuse, and with an additional load on, it may prevent the escape of the heat, and tend to make it blow sooner, particularly if the overload persists for some time. This does not seem of great importance, however, as the function of a fuse is rather to protect mains in case of short circuits than to go with loads not very much higher than normal full load. The asbestos ought to reduce, and help to extinguish, the arc, and to keep the metal from flying. If it does this efficiently it will be of considerable value. Fuses should be protected by some kind of cover, preferably of an insulating nature.

It seems probable that porcelain is not the best carrier for fuses. It is brittle, and may fly on severe short circuit. Fuse carriers would be safer if made of something of a tougher nature, which would tear and not splinter.

Fuses, of course, require switches in series. If clip replaceable fuses are used, the fuse may be on the live side of the switch. The fuses should be high up, well above the head of the attendant when he is closing the switch, it being assumed that he keeps his head well down. Sometimes fuses are put low down and the switch is placed above, but this arrangement has caused accidents when the switch was closed on a bad short, as fuse parts have been known to fly and hit the limbs of the attendant, with unpleasant results.

It would be of some advantage if the switches could be operated by a long portable handle. With some such arrangement and a good design of fuse, there seems to be no reason why sub-station fuses should not be quite satisfactory, even at 500 amps. capacity, with large power behind them.

TELEPHONE CABLES FOR USE IN POWER SCHEMES.

By AN EXPERT.

With the advent of much larger power supply areas, the subject of communication between the central station and distant points, such as sub-stations, assumes greater importance, and the following notes on telephone cable will probably interest those dealing with power distribution.

To prove satisfactory, a telephone cable used with a power scheme must meet the following requirements:—

1. It must be absolutely reliable under all conditions of service.
2. For economic reasons the first cost should be low, the maintenance costs negligible.
3. The design of the cable should be such that it will give reasonably good speech transmission over the longest distance for which it would be used.

Of these requirements, the first is by far the most important, since it is obvious that if communication cannot be relied on at all times the system is worse than useless. The second and third requirements will be discussed later, although it may be pointed out now that the question of speech transmission is not likely to cause trouble over the distances normally required, especially if good quality instruments be used.

There are three types of telephone cable in general use for the purpose under consideration:—

1. Dry core, lead-covered telephone cable.
2. Telephone cable in which the insulation consists of impregnated paper loosely applied, lead covered.
3. Telephone cable in which the insulation is of solid impregnated paper, lead covered.

All of these types are used with different kinds of external protection when this is necessary.

The *dry core cable* is the standard type for use on telephone systems, and is constructed as follows:—

The conductors are insulated with one or more loosely applied wrappings of dry paper. These insulated conductors are twisted into pairs, and the required number of pairs is built up in layers to form a round core. A final binding of dry paper is next put on over the core, which is then enclosed in a lead sheath. While this type of cable is admirably suited to large telephone systems where the staffs are well trained in its installation and maintenance, it has two big disadvantages when used in connection with power supply systems. First, owing to the ease with which the paper wrapping will absorb moisture, special precautions have to be taken while the cable is being jointed, and unless the jointer is used to this class of work, low insulation will result. This will necessitate special drying apparatus to clear it. In the second case, should the sheath become punctured after the cable is laid, moisture will penetrate for long distances on either side of the joint. This effect takes place very rapidly, and if there is much moisture in the ducts or soil surrounding the cable, replacement will be necessary. The length to be replaced in this event will be considerable, thus precluding anything in the nature of a quick repair. Of course these troubles occur also in large telephone systems, but here the failure is not vital, since spare circuits are generally available. In these systems the advantages of increased transmission efficiency outweigh the disadvantages, especially as the latter are minimised by the skilled staffs and special apparatus available.

Cables with the loose impregnated paper type of insulation are of similar construction to the dry-core type, except that for insulating the conductors, impregnated paper is used instead of dry paper. A double spiral wrapping of paper is usually employed on each conductor. This type is probably the best of all for the use under consideration. Joints are simple to make, and the jointers employed would be quite familiar with this kind of insulation, since it is similar to that on power cable. Also, since the cable is filled with impregnating compound, any moisture penetrating the sheath is not likely to travel far up the cable. Repairs in this case can, therefore, be quickly effected by cutting out and replacing a short length. As to mechanical and electrical strength, there is no doubt that this type of cable, when properly made and laid, can easily withstand any conditions likely to be met in normal use. In addition, it has the advantage of being the least expensive type.

The best description that can be given of the third type, *cable with solid paper insulation*, is to say that it is a miniature power cable. In this type the conductors are insulated with lappings of impregnated paper applied so as to form a solid core. These cores are laid up together either as singles or pairs, lapped with more paper, and lead covered. Either method gives a very bulky, and therefore uneconomical, telephone cable, especially when pairing is required. This type of cable is frequently specified when there is very little justification for doing so, since a cable of the second type will stand any induced voltages likely to be met with normally. In the unlikely event of a telephone conductor coming into contact with a high-pressure circuit a breakdown is inevitable, whatever type of insulation is used.

To complete the comparison, the relation between the costs of these types must be taken into consideration. As would be expected, there is little or no difference between the costs of the dry core and the loose impregnated paper types, while the cost of the solid impregnated paper type is from two to three times that of the other two types, depending, of course, on the thickness of insulation specified.

The reasons, therefore, for selecting the second type of cable as the most suitable for use on a power scheme are as follows:—

1. While it is no cheaper than the dry-core type, it is easier to lay and maintain, since it requires no special training on the part of the jointer, and no special apparatus to keep it in working order.

2. It costs from one-half to one-third the amount of the solid insulated type, and while its factor of safety from an electrical and mechanical point of view is not so high as that for the solid type, it is ample for the purpose under consideration.

Having arrived at a conclusion as to the type of cable required, it is now necessary to see what size of conductors, and how many of them, are necessary. The standard sizes of conductors used for telephone work in this country are stated in pounds per mile. The diameters are as follows:—

10 lb. p.m.—.025 in.	70 lb. p.m.—.066 in.
20 lb. p.m.—.0355 in.	100 lb. p.m.—.079 in.
40 lb. p.m.—.050 in.	

When considering a telephone cable these sizes should be adhered to as far as possible, since all telephone cable manufacturers have machines equipped for dealing with these sizes. They also hold stocks of these wires, and it is therefore reasonable to expect a saving in cost and a quicker delivery if these sizes are specified. There is very little reason for specifying stranded conductors in telephone cables. A stranded conductor, of the small size necessary for this class of work, gains little in strength or flexibility over a solid conductor, and is more expensive. To enable a decision to be made as to the size of wire necessary, the following table gives the distances over which good commercial speech is possible with a given size of conductor:—

Miles.	Miles.
10 lb. p.m.—5	70 lb. p.m.—30
20 lb. p.m.—10	100 lb. p.m.—40
40 lb. p.m.—20	

These figures make allowance for any instrument and terminal losses that are likely to occur.

When fixing the size of conductors and the number of pairs required, possible future extensions should be borne in mind. Regard should be paid to the fact that a one-pair telephone cable is rarely economical, since a two or three-pair cable may be obtained for little extra outlay. Even if only one circuit is wanted, with no probability of increasing this number, a two-pair cable should be considered. Provision is then made for a stand-by circuit should the one in use happen to fail.

The only remaining point now left to consider is the thickness of sheath required. This naturally depends on the diameter of the cable, but to obtain the necessary mechanical strength the radial thickness of sheath should not be less than .065 in. This is the usually accepted figure in this country for a minimum lead thickness on any lead-covered telephone cable, however small. The reasons which cause some engineers to specify exaggerated lead thicknesses are difficult to understand. Of course, this may lessen electrolytic action by reducing the current density in the sheath, but it will not prevent electrolytic action entirely. Attacking the problem from the point of view of taking precautions to prevent electrolysis would seem to be a cheaper and more logical method. The same argument applies to chemical corrosion. Increasing the lead thickness simply delays failure and does not prevent it entirely. A protective covering designed to meet the particular case where chemical corrosion is expected, would prevent failure, and would offer a much cheaper solution of the problem.

Wages in the Clyde Area.—Forty-one firms in the Clyde area have agreed not to reduce the wages of the contracting members of the Electrical Trades Union by 3d. an hour. Many of the employers who are observing Union terms are federated firms. —*Daily Herald.*

CURRENCY AND BANKING.

Mr. H. G. Williams, M.Sc., M.Eng., A.M.Inst.C.E., secretary and general manager of the Machine Tool Trades' Association, recently delivered two lectures under the auspices of the Manchester Engineering Council on the subjects of currency and banking, and foreign exchanges and foreign trade. He dealt with these important subjects clearly, and on orthodox lines, explaining in the first instance the use and growth of currency and how it came to supplant, almost everywhere, the older method of barter. He pointed out the essential qualities of money, first as a medium of exchange, and second, as a measure of value. He pointed out the advantages of a metal coinage, carrying intrinsically its own face value over a paper currency such as we now possess.

Banking operations and the natural limitations to credits were next dealt with, and it was shown how a bank must always keep sufficient reserves to deal with emergencies.

We think, however, that Mr. Williams momentarily relapsed into pre-war thinking, when he remarked that "if anything cause alarm, the people who possess notes may present them and demand gold."

With regard to paper money, he remarked that its value depended upon the faith reposed in it by the people; but that in most countries the present cause of depreciation was not lack of their faith, but was due to the creation of credit by inflation of paper money, which automatically put up the price of commodities. At the same time he admitted that the manufacture of credit was not the sole cause of the rise in prices above the purchasing power of the people, with the disastrous slump that followed.

The pressure on the banks to carry the burden of the stocks, the heavy taxation, and other factors, all aggravated the slump.

Mr. Williams thinks that with a reasonable sacrifice of wages on the one side and profits on the other, trade may soon be restored; but he suggests as one remedy a "hair of the dog that bit us," viz., a little more judicious inflation of credit to get business on the move again.

His second lecture was devoted to the question of foreign exchanges. Mr. Williams attributed our adverse exchange in the U.S.A. almost entirely to our adverse balance of trade, viz., "that we are constantly importing more from America than we are sending to her." He dealt with this matter very clearly; but we hardly think he gave due weight to political considerations, which, of course, have a great influence.

He pointed out how the exchange could be rectified by movements of gold, but, of course, this presupposed gold available to be moved.

The rates of exchange as between this country and the U.S.A., and France and Germany, were fully considered, and also the important question of the Indian and Eastern exchanges was touched upon.

Mr. Williams concluded with the expectation that, as soon as we get the New York exchange to $4.86—that is, to the normal figure—we could restore the gold standard at once.

In our opinion, it is of great advantage that the trading community, and especially engineers, should understand at least the principles underlying these great questions of currency and exchange, and not leave them entirely to the money experts; and Mr. Williams did a very useful service to the engineers of Manchester in presenting them with these two excellent lectures, which at least put forward the generally accepted views clearly and concisely.

To any of our readers who may feel inclined to follow up the subject, we would venture to recommend a book entitled "Inflation," by Prof. J. Shields Nicholson, of Edinburgh, which gives a very interesting and masterly account of the present position; or rather we should say (as the position changes so fast) the recent

position. He lays bare the disastrous course of our Governmental borrowings and spendings, and shows clearly enough how the present financial position has been reached.

Unfortunately, neither he nor any other exponent of the "dismal science" seems able to show how or when we are to get back to a satisfactory basis. They all say return as soon as possible to the gold standard, or, in other words, restore the convertibility of our paper currency into gold; but how, or when, is not indicated.

After all, we think it is possible to overstate the importance of the currency, which is only the medium.

The worthlessness of Russian paper is not only inherent in the reckless quantity that has been printed. If people had confidence in the Russian Government things might soon be altered even there.

However, the great bulk of our trade is carried on by cheques and bills of exchange, and the measure of our credit is the measure of the confidence reposed in us that we will, as heretofore, keep to our bargains.

If we could only get our political and industrial problems solved, and settle down to steady production, our credit, and eventually our foreign trade, would soon be back at a high level.

SMALL ACCUMULATOR DEFECTS AND THEIR REMEDIES.

By "VOLTMAN."

The class of small portable accumulator, ranging in type and size from that used for automobile lighting and starting down to the miniature single cell employed in pocket lamps, requires special treatment and handling to obtain the best results—this has been the writer's experience. One cannot successfully apply the same rules that should be observed in the case of large fixed batteries. With every part made on so small a scale, and with very limited clearances, not to mention a certain fragility of material, it is inevitable that a number of minor troubles are likely to arise, which are absent from the large fixed battery. The small accumulator also gets a good deal of knocking about by inexperienced hands.

In general, small cells seem to be very susceptible to incorrect specific gravity of the acid, and if neglected have a strong tendency to sulphate. The quantity of acid per cell is necessarily small, and regular testing of the specific gravity is advisable. Frequently it will be found that the acid is too weak, as users of these batteries generally overdo the adding of water to make up for loss by evaporation. The most convenient form of hydrometer for testing the specific gravity is the pipette having a rubber bulb and a float inside the glass vessel.

Breaking away of the active material from the plates is very common, due to vibration chiefly, and as the plates are very close together, and not always provided with a complete separator, loose active material becomes wedged in between them. A narrow strip of whalebone, very thin and flexible, which can be inserted through the vent, is very useful for dislodging these troublesome fragments of active material, and causing them to fall to the bottom of the cell. A very puzzling defect the writer has experienced is that of a leak in the dividing piece between the cells, thus causing a slow but sure running-down on open circuit. It is only detected by emptying one cell, when the acid will be found to percolate through from the other. This defect is only repairable by opening up the case and recementing the leaky joint with celluloid cement (celluloid dissolved in acetone). Repairs to celluloid cases on the outside are quite easy to effect with thin sheet celluloid and cement (for this purpose worn-out season ticket cases answer admirably, as patches and angle pieces are readily made thereof). For similar defects in ebonite cases nothing is so good as the ever-useful Chatterton compound.

The bugbear of terminal corrosion is not so common nowadays, but short of using all-lead connections it is always prone to occur. The old dodge of vaselining the terminals is only a temporary remedy. If the defective rubber gland cannot be renewed the acid will inevitably creep up and attack the brass. The writer recommends painting round the gland and lower part of the terminal with anti-sulphuric enamel, and coating the terminal head, by first heating it and then rubbing the surface with a piece of shellac or sealing wax. This produces a durable acid-proof coating.

Instances of small accumulators slowly discharging on open circuit may often be traced to current leakage due to a conducting film of acid forming on the upper surface of the case. By flowing some melted paraffin wax thereon, this surface leakage is greatly reduced, as the wax has a repellant effect on acid tending to settle on the surface.

Lug fractures inside the cell are sometimes a puzzling source of trouble, as the break may not be visible nor yet completely interrupt the circuit, but will produce a bad contact. A good repair can generally be made by the manufacturers by burning on a new lug. Outside connections also sometimes break at the point where the weld has been made, and this is not always noticed. Such connections appear to be too rigid to withstand the vibration that some batteries are subjected to. It is, however, a simple matter, on locating such a break, to remove the connector bar and solder a strip of thin lead to the lugs, making a bend or loop in the strip to provide sufficient flexibility.

ELECTRICAL MACHINERY IN THE MALAY PENINSULA.

In the past the amount of electrical plant that has gone to the Malay Peninsula has not been very great; but with the development of the industries of the country and its gradual opening up to civilised conditions there is reason to believe that its requirements of machinery of all sorts will increase. The statistics of the Straits Settlements show the value of imports and exports of electrical machinery for three years as follows:—

	Imports.	Exports.
1917	£60,525	£18,795
1918	55,189	2? 191
1919	153,590	3?,795

Though classified as exports, the electrical goods sent out of the Straits Settlements do not leave the Peninsula but find their way into the Federated and Unfederated Malay States—in 1917 to the value of £14,823; in 1918, £10,317; and in 1919, £22,818.

It will be interesting to merchants and manufacturers in this country to know whence British Malaya draws its supplies of electrical goods, and this is shown in the following table:—

	1917.	1918.	1919.
United States of America ...	£17,293	£9,179	£74,593
United Kingdom	28,569	17,028	50,430
French India	—	—	16,643
China	422	7,674	4,651
Australia	796	792	1,074
Italy	1,753	933	857
Japan	8,195	13,806	811
Hong-Kong	1,231	1,688	692

The most remarkable feature of the above statistics is the supply of goods of this description from Asiatic countries, especially French India. The imports from Hong-Kong and the China coast ports may be merely transhipments from Japan, the United States or elsewhere.

In the Federated Malay States, the supervision of electrical machinery is entrusted to the Senior Warden of Mines; and from Mr. W. Eyre Kenny's report for 1919 it appears that the number of installations of generating plant in these States was as follows:—1917, 100 installations (8,976 kW); 1918, 106 (9,360 kW); 1919, 109 (9,544 kW.). In addition there were 20 self-contained lighting plants installed in private houses, plant to about 1,300 kW was in course of installation at the end of 1919, the aggregate horse-power of motors employed was 9,320 as against 9,660 in 1918, and a census taken in December showed that motors totalling 3,400 h.p. were available as spares but were not connected.

A classification of all electrical generating plant employed in

the Federated Malay States in 1919 was given in kW as follows:—

	Power.	Light.
Mining	8,758	189
Agriculture	68	216
General	110	146
Government	131	2,537
Total	9,067	3,088

The horse-power of motors employed for all purposes aggregated 11,560, as compared with 11,900 in 1918.

It is regrettable, writes Mr. Eyre Kenny, that so many different frequencies and voltages are in use on mines. Mine owners would be well advised to adopt British Standard frequencies and voltages. For three-phase power installations a frequency of 50 and a voltage of 400 or 500 at motor terminals will meet requirements in the majority of cases; for continuous current plant a voltage of 500 is in general use and may well be adopted. For lighting, a voltage of 115 or 230 is practically in standard use in the Federated Malay States and the Straits Settlements, and although not British Standard, it would be advisable to adhere to these pressures.

In the Malayan collieries at Rawang, in Selangor, three new 300-kW steam-driven generators were installed, a ninety-eight inch "Sirocco" ventilating fan was brought into use, two storage battery electric locomotives for underground use were imported and have rendered good service, and a long wall electrically-driven coal cutter with an electrically-driven coal conveyor were being installed at the end of the year.

In the report for 1919 of the Director of Public Works (Mr. R. O. N. Anderson) it is stated that the Gombok section of the Kuala Lumpur electric light installation gave a great deal of trouble during the year, and there were many stoppages, the chief reason being the "wearing-out" of the generator coils. "It has been impossible to get new ones anywhere," wrote Mr. Anderson, "and there is no apparatus for carrying out repairs satisfactorily here," but doubtless this has since been remedied. Sale of energy brought in £23,567, against £24,047, and the gross profit was £12,519.

RECENT DEVELOPMENTS IN TURBINE PRACTICE.

By K. BAUMANN.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

In 1912 the author read a paper before the Institution describing the development of the steam turbine up to that date.* The present paper generally outlines turbine practice during the interval, reviews the circumstances which resulted in developments which can be best described as the "race for the maximum output at the highest possible speed," describes how progress has been made possible, and deals in detail with the problems connected with the large turbines required for electric power stations of the future.

Part I.—Summary of Development.

From a list of turbo-alternators built by various makers during the past ten years it appears that the largest alternator with a speed of 1,000 r.p.m. was built by the A.E.G. in 1918. This 50,000-kW set was very expensive, and future progress will be towards increasing the output of 1,500-r.p.m. machines rather than developing 1,000-r.p.m. sets. The largest 1,500-r.p.m. machine at present in operation has a capacity of 35,000 kVA (maximum continuous rating), and most manufacturers are willing to build an alternator of this size. A 35,000-kVA alternator has been built for a speed of 1,800 r.p.m., and the capacity of this machine is equivalent to 50,800 kVA at 1,500 r.p.m., on the basis that the maximum possible capacity varies inversely as the square of the speed (r.p.m.). Fig. 1 shows the growth of the maximum continuous kVA rating reduced to 1,500 r.p.m. diagrammatically.

A list of turbo-alternators running at high speeds (2,400 r.p.m. and above) which have been built during the last ten years shows that the capacity has increased in this country from about 3,000 kVA in 1912 to 17,200 kVA maximum continuous rating in 1921. Fig. 2 shows the growth of the maximum continuous kVA rating reduced to 3,000 r.p.m. diagrammatically.

The d.c. generator driven directly from the turbine has disappeared from the market, its place having been taken by the moderately low-speed generator driven by mechanical reduction gear, up to units of 4,000 kW, and for larger units by turbo-alternators in conjunction with rotary converters. The development of the reduction gear is also responsible for the disappearance of the direct-driven 25-period alternator running at 1,500 r.p.m. up to capacities of 4,000 kW, and has completely revolutionised turbine practice for small outputs; the time is not far distant when even the 1,000-kW, 3,000 r.p.m. turbo-alternator will be replaced by a turbine running at a high speed and driving the alternator through gears.

The most economical arrangement of the geared turbine for large capacities is the "two-pinion" arrangement, one pinion being driven by the h.p. and the other by the l.p. turbine. In such a case the output which can be transmitted through the pinions very nearly approaches the maximum output which can be obtained from the turbine when designed for a 29-in. vacuum.

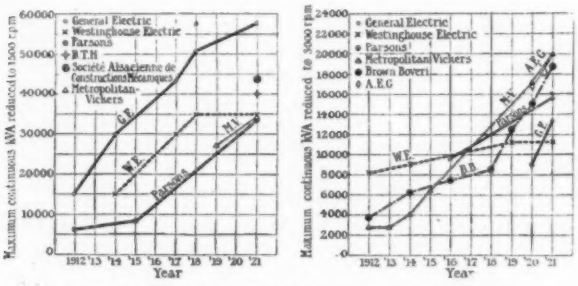
The development of the economical rating for each exhaust is of particular interest. This rating reduced to a basis of 1 in. abs. back pressure and a speed of 1,500 r.p.m. is shown in fig. 4, and fig. 5 shows corresponding particulars of high-speed turbines (above 2,000 r.p.m.) of relatively large capacities.

Regarding the development of the reaction turbine, in 1910 the combined Curtis-Parsons turbine was introduced by Messrs. Brown, Boveri, and has since become their standard design, built as a single-cylinder unit in every case. The l.p. end is built up of disks, the peripheral speed of the rotor being too high for the use of drums. In this country, and in America, development has proceeded on different lines. Parsons in this country standardised the two cylinder design for large capacities, the h.p. and l.p. elements being arranged in separate cylinders, arranged in tandem for driving a single generator. In order to cope with large volumes of exhaust steam, the l.p. element is generally of the double-flow type. Fig. 6 shows a representative design of Parsons 11,000-kW, 2,400-r.p.m. turbine.

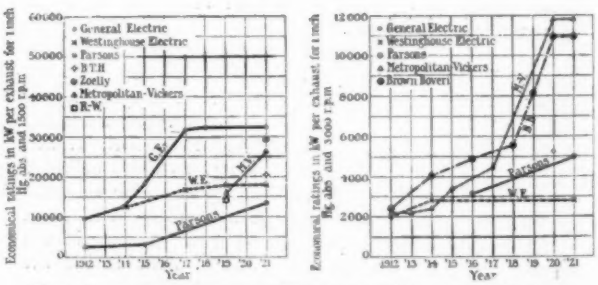
The Westinghouse Electric & Manufacturing Co., Ltd., in America has further developed the sub-division into separate cylinders to improve the efficiency and deal with the demand for increased capacities; some of its units were built for driving more than one generator.

The first Ljungström turbine of 1,000-kW capacity was installed in 1912 by the North Metropolitan Power Co., London, and since then considerable progress has been made. A Ljungström turbine of 30,000-kW maximum continuous capacity is at present under construction in the works of the General Electric Co. at Schenectady.

A conspicuous feature of the development of the impulse turbine is the increase in the output per cylinder. The prominent firm in this connection is the General Electric Co. of America. The necessary leaving area in this single cylinder



Figs. 1 and 2.—Growth of Max. Cont. kVA Rating of Alternators, Reduced to 1,500 r.p.m. (left) and to 3,000 r.p.m. (right).



Figs. 3 and 4.—Growth of Economical Rating of Turbines in kW per Exhaust, Reduced to a Vacuum of 1 in. abs. (Hg) and 1,500 r.p.m. (left), and to 3,000 r.p.m. (right).

* Elec. Rev., Feb. 23rd, 1912; p. 317.

unit has been obtained by increasing the diameters of the last stages and increasing the length of the blades. The great difference in overall length, and the additional cost involved in the two-cylinder construction, are no doubt responsible for the early change-over to the single-cylinder construction. Experience has shown, however, that single-cylinder construction possesses serious inherent disadvantages due to disk and blade vibrations.

In the A.E.G. 3,000-r.p.m. turbine of 30,000-kW capacity in one cylinder, the last stage is arranged on the double-flow principle, the exhausts from the two halves facing one another. The steam passages from the last but one row to one half of the last stage are arranged around the last stage, and the exhaust steam is caused to flow around these passages before entering the exhaust proper. The flow of steam outside the last stage is very complicated, and will result in a considerable drop in pressure between the last row of blades and the condenser, and also between the last but one stage and the extreme half of the last stage.

A number of 16,000-kW turbines designed to run at 1,500 r.p.m. have been built by the A.E.G. for large super-power stations such as Golpa. This design is conspicuous for its small number of stages and for the large diameter of the last three stages. The length of the blades on the last wheel is very small, the ratio of blade length to mean diameter being only 1 : 9. The shape of the turbine exhaust is very unsatisfactory from the point of view of flow of steam through the exhaust, inasmuch as 50 per cent. of the exhaust opening is covered by the turbine cylinder which is overhung into the turbine exhaust.

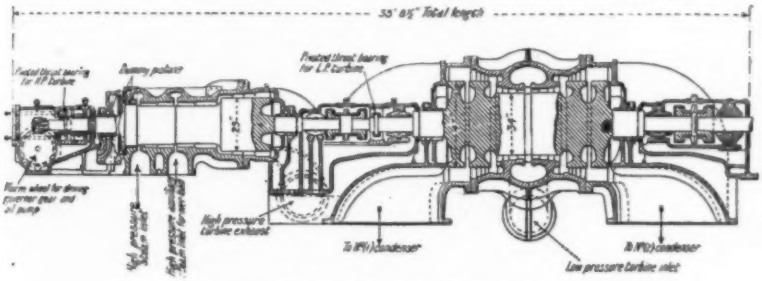


Fig. 5.—Parsons Tandem Reaction Turbine at Carville, Newcastle-on-Tyne, 1916.

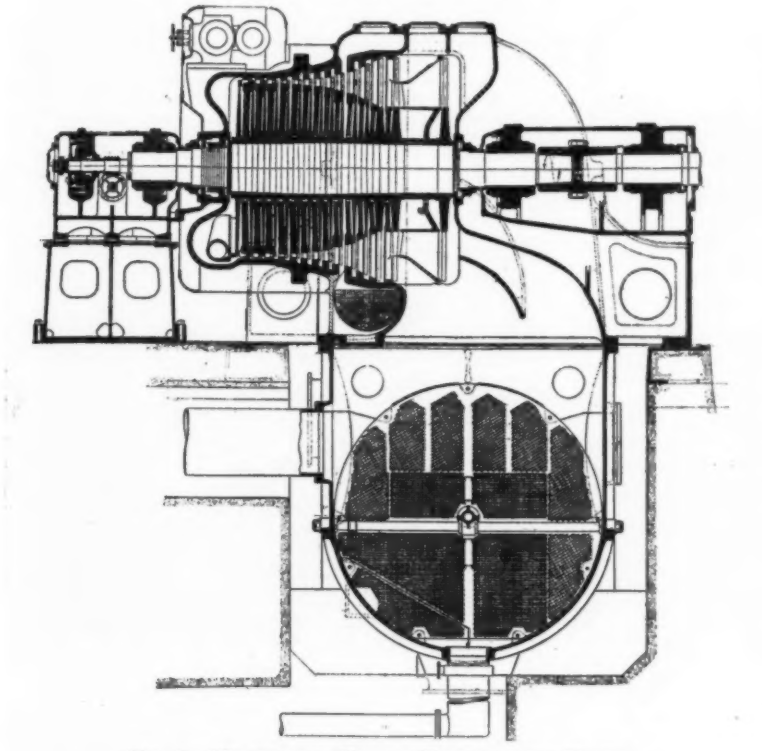


Fig. 6.—Metropolitan-Vickers Turbine with Heater and Condenser, at Dalmarnock, Glasgow, 1919.

During the period under review no designs of Zoelly turbines which differ materially from the construction described in his paper of 1912 have come to the author's notice. It has been reported that 10,000-kW turbines running at 3,000 r.p.m. are under construction, but no details of designs have been published.

Modern Rateau turbines are built by the Metropolitan-Vickers Electrical Co.,* and figs. 6 and 7 show a multi-exhaust, 18,750-kW, 1,500-r.p.m. turbine with other novel features.

The stream-line exhaust secures a simple flow of the steam, thus reducing to a minimum the pressure-drop between the last row of blades and the condenser. It also ensures uniform distribution of steam over the whole condenser-tube surface, thereby effecting a reduction of pressure-drop in the condenser itself. A surface-type feed-water heater is arranged within the turbine cylinder, the tubes in which the condensate is heated being exposed to steam which is tapped from the main turbine at a relatively low vacuum. The incorporation of the heater as an integral part of the turbine avoids the necessity of additional heater casings and pipe connections which would complicate the lay-out of the plant to a considerable extent. The exhaust casing is rigid in construction and is placed directly on the foundations, thereby dispensing with the use of heavy foundation girders. The condenser inlet flange is bolted directly to the turbine cylinder. The h.p. end of the turbine is flexibly connected to the rigid portion of the casing, the extreme end of the h.p. cylinder being supported from a pedestal. In the old-fashioned design heavy foundation girders are usually required to provide side supports for the turbine, which increase the cost of foundations and interfere seriously with the accessibility of the joint between the turbine and the condenser. The pipe type of nozzle box and steam chest combined with nozzle control is such that the highest steam pressures and temperatures can be used without fear of distortion of the turbine cylinder due to variations in load and steam temperature.

A comparison of the commercial development of impulse and reaction turbines shows that prior to the war the position, as far as European countries are concerned, was roughly as follows: Impulse: Number of makers, 30; number of turbines, 900; output, 1,400,000 kW; and average size of turbines 1,550 kW. Reaction: Number of makers, 9; number of turbines, 250; output 500,000 kW; and average size of turbines, 2,000 kW. Similar information for this country for 1919 is: (Orders in Great Britain for turbines above 200 kW capacity) Impulse: Number of turbines, 143, output 411,568 kW; and average size of turbines, 2,870 kW. Reaction: Number of turbines, 46; output, 112,407 kW; and average size of turbines, 2,440 kW.

Concerning machines for special purposes the demand for low and mixed pressure turbines has considerably decreased, but there has been an increased application of back-pressure and reducing turbines to mills and factories. The sizes of units required are moderate, and the practice has not changed appreciably during the period under review.

Part II.—Factors Affecting Development.

The author discusses all the points in design which affect reliability, and gives such data as will enable the power-station engineer to appreciate the merits of any particular turbine design.

The progress made in steam conditions shows that at present steam pressures as high as 350 lb. per sq. in. (gauge) are being adopted and temperatures as high as 750 deg. F. The vacuum has been increased from 29 to 29.1 in.; the heat drop from 407 to 485 B.th.u. per lb., and the ratio of expansion from 418 to 828. Higher steam pressures than 350 lb. per sq. in. are at present not justified except in power stations where economy is of extreme importance, where coal is very expensive and the load factor very high. A steam temperature of 700 deg. F. is the present standard.

The basis of calculations for the improvement in heat consumption possible with improved steam conditions is explained and improvements due to higher steam pressures, temperatures, and vacua are discussed in turn as well as those due to reheating and feed-water heating. Finally, the author turns to thermo-dynamic efficiency, and points out that the advantages of the velocity wheel are outweighed by the increased efficiency of single Rateau stages, except in cases where the diameter used for the first stage is relatively small. There is a tendency for the h.p. end of reaction turbines to be replaced by impulse stages not necessarily of the velocity-wheel type, but also of the ordinary Rateau type. For the middle portion and the l.p. end both impulse and reaction blading continue

* Elec. Rev., Apr. 30th, 1920, p. 571.

to be used, but reaction blading has largely given way to impulse blading.

Part III.—Economic Rating.

It is possible to design a given turbine frame for any rating within a given range, and the economical consumption at such designed ratings will lie along a curve D, fig. 8, which is defined as the "economical consumption characteristic" for the given turbine frame for given steam and vacuum conditions, and the problem is the determination of the particular point along curve D at which the economic rating can be fixed for a given load factor, fuel costs, capital charges, &c.

The manner in which the losses vary with the rating of a given size of turbine for given steam and vacuum conditions is shown in fig. 8 [steam pressure 200 lb. per sq. in. gauge, superheat 200 deg. F., and 29 in. vacuum].

Curve A shows the variation of the steam consumption s_b in lb. per kWh at the blading if c^2 losses do not exist. This consumption is independent of the rating, and curve A is, therefore, a horizontal line. Curve B shows the variation of the mechanical losses expressed as a percentage of the output measured at the coupling. In the case considered [20,900 kW at 1,500 r.p.m.] the mechanical losses $K_m = 835$ kW. Curve C

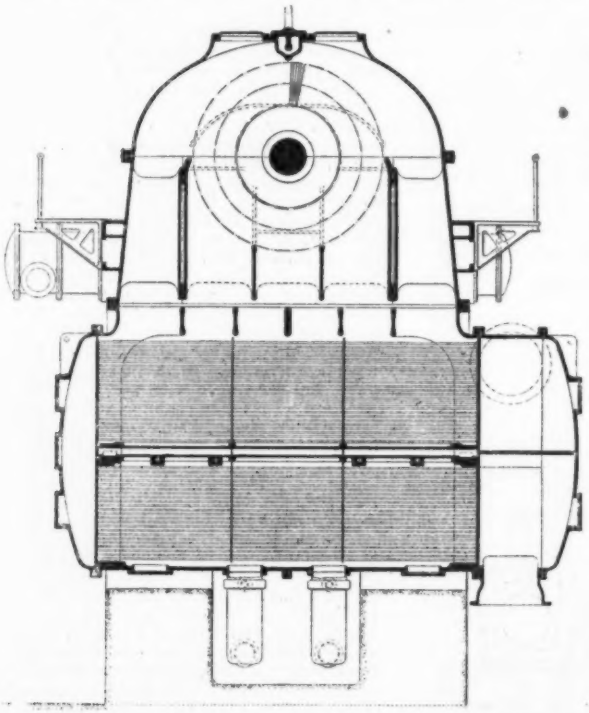


Fig. 7.—Metropolitan-Vickers Multi-exhaust Turbine at Dalmarnock.

shows the variation of the c^2 losses expressed in percentage of the total heat drop available for a back pressure of 1 in. abs. These losses vary approximately as the square of the rating. Curve B plus C shows the variation of the total losses expressed as a percentage of the output at the turbine coupling. Curve D is the economical consumption characteristic, and shows the variation of the economical steam consumption for the various designed ratings referred to the outputs at the turbine coupling.

In actual practice it does not pay to design a given turbine frame for the rating which gives the lowest possible steam consumption, because the turbine will be too expensive for such a rating. In order to determine the commercial economic rating of a given turbine frame (the "economic" rating), it is necessary to consider the relative influence of the fuel and capital cost charges per kWh on the generating costs. The capital cost of the turbine itself varies inversely as the rating, whereas the fuel charges increase from the point of maximum efficiency with the rating.

The effect of the fuel and capital charges is such that for a back pressure of 1 in. abs. the rating becomes $K_e = 32{,}500$ kW, *i.e.*, 1.55 times the minimum steam-consumption rating of 20,900 kW. The corresponding outlet losses become $l_o = 4.6$ per cent. For a back pressure of 2 in. abs. the rating becomes 45,000 kW or 1.38 times the economic rating for a back pressure of 1 in. absolute. The corresponding outlet losses for 2 in. abs. are $l_o = 3.19$ per cent. or 69.3 per cent. of the corresponding losses for a back pressure of 1 in. abs.

For a load factor of 25 per cent. the economic rating of a given frame is 20 per cent. larger than for a load factor of 50 per cent., the outlet losses being 40 per cent. larger; on the other hand, if the load factor is 75 per cent., the rating would be reduced by 10 per cent. and the outlet losses by 20 per cent. The economic rating varies approximately inversely as the fourth root of the load factor, and the losses vary inversely as the square root of the load factor, and similarly it follows that the economic rating varies: Inversely as the fourth root of the cost of coal; or directly as the fourth root of the interest factor; or directly as the fourth root of the

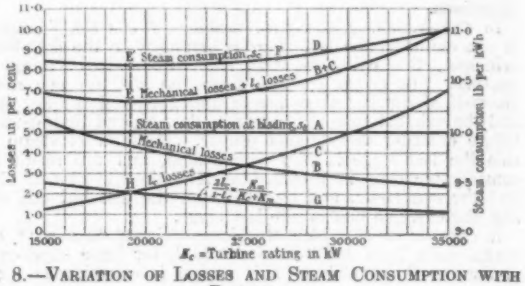


Fig. 8.—Variation of Losses and Steam Consumption with Rating.

evaporation; or finally, directly as the fourth root of the initial cost of the turbine.

Thus, for an increase of 20 per cent. in the cost of the turbine, the rating of the turbine should be increased 5 per cent., provided that the cost of coal remains the same. It will generally be found, however, that the cost of the turbine increases with the cost of coal, these factors being industrially interdependent. The rating of the turbine would accordingly remain unchanged.

The leaving losses vary, inversely as the square root of the cost of coal; or directly as the square root of the interest factor; or directly as the square root of the evaporation; or finally, directly as the square root of the initial cost of the turbine.

In the cases considered above, no account is taken of the fact that, by installing a more efficient turbine, the boiler-house plant may be made smaller, resulting in decreased interest and depreciation charges for the boiler plant, and of charges for maintenance and operation. The same applies to the condensing plant, the size of which depends, amongst other things, on the quantity of steam discharged from the turbine. Moreover, an increase in turbine efficiency reduces the heat content per lb. of steam. For every 1 per cent. improvement in steam consumption, the amount of heat to be dealt with per kW capacity of the installation is decreased by about 1.4 per cent., which is the amount by which the capital cost of the condensing plant will be decreased.

Fig. 9.—Three 20,000-kw. and one 45,000-kw. Turbo-Generators at Connor's Creek (see p. 475).

It may be urged that such fine limits cannot be obtained in actual practice. It is clear, however, that even if the sizes of the various parts of the plant are fixed by other considerations, considerable advantages can be obtained since, for an increase in turbine efficiency, the boiler plant will be more easily rated in actual operation, thereby effecting a reduction in maintenance charges and also an increase in boiler efficiency. The same remarks apply to the condensing plant where a decrease in turbine consumption results in a higher vacuum and, consequently, in a further improvement in economy.

For the best commercial rating of the boiler or condensing plant the saving in capital cost for a given increase in rating is equal to the extra fuel cost entailed by the same increase in rating. Therefore, the financial gain resulting from the use of a more efficient turbine is equivalent to that which would have resulted had correspondingly smaller boiler and condensing plant been installed.

The saving resulting from the reduction in the steam-capacity costs is of the same order as the direct saving in

fuel costs, and both factors must be considered in determining the economic rating of the turbine.

Thus, for a back pressure of 1 in. abs. the most economic rating becomes 28,400 kW, and the outlet losses are 3.54 per cent. For a back pressure of 2 in. abs. the rating becomes 41,000 kW, or 1.42 times the rating for 1 in. abs., the corresponding outlet losses being 2.52 per cent., or 0.7 times the losses for 1 in. abs.

When allowance is made for the steam-capacity costs the effect of such factors as cost of coal, initial cost of turbine, &c., on the rating becomes smaller, simply because the influence of such factors is offset to some extent by the influence of the steam capacity. The variation of the overall economic rating with coal cost, load factor, &c., is only about one-half of that which is obtained in the case of the economic rating.

It is evident from the foregoing that if too high an average cooling-water temperature is given to the manufacturers, as is often the case, the turbine will be large enough as far as load-carrying capacity, *i.e.*, steam-chest and nozzle capacity, is concerned, but the exhaust end will be too small, thereby impairing the efficiency of the turbine. On the other hand, if too low a temperature is given, the turbine will be unnecessarily expensive. American practice has standardised turbine ratings on the basis of a vacuum of 29 in. (barometer 30 in.) although the average cooling water temperature would justify a vacuum slightly higher than this.

[To be continued.]

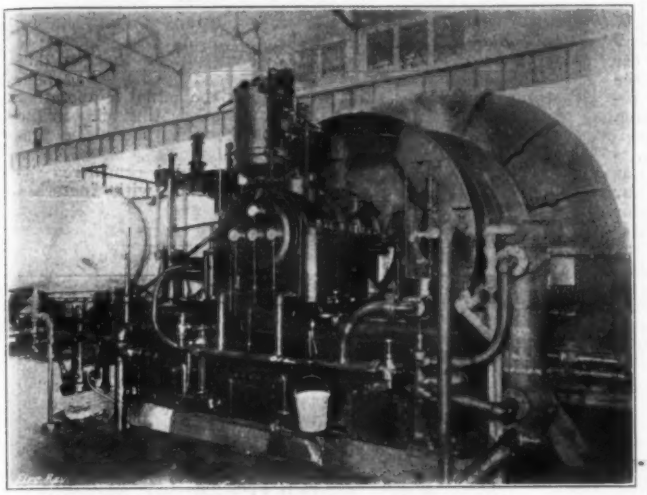


Fig. 10.—Steam End of 45,000-kw. Turbine

Fig. 12.—Cracked Semi-steel Casing.

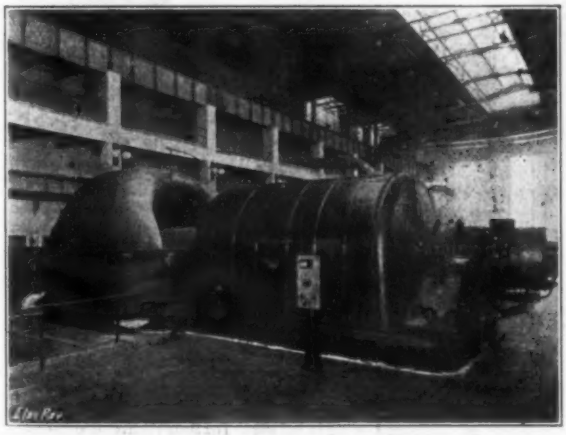


Fig. 11.—Generator and l.p. End of 45,000-kw. Machine.

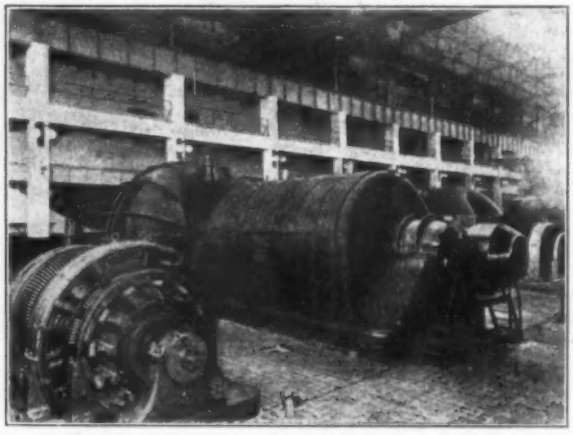


Fig. 13.—Generator and Ribbed 45,000-kw. Turbine.

Discussion in London.

Mr. W. H. Patchell opened the discussion by referring to some of the large machines he saw during his recent visit to America. He had a number of lantern slides thrown on the screen (from which our illustrations have been reproduced), and explained that fig. 9 was a view down the engine room of the Detroit Edison Co.'s Connor's Creek station showing three 20,000-kW machines in the foreground and one of the 45,000-kW (1918) sets in the background; the latter machines were the largest single-shaft turbo generators in the U.S.A. Fig. 10 showed the steam end of the large machine, and some idea of its size might be gained from the fact that the distance between the centre line of the shaft and the floor level was 7 ft. The machine was a 21-stage turbine, running at 1,200 r.p.m., with a maximum tip speed of about 726 ft. per second; its overall length was 64 ft., and the weight of the stator, which the speaker saw placed in position, was 115 tons. The heavily-lagged steam pipe was 22 in. in diameter. As an illustration of the station's war-time troubles, the speaker mentioned that the 20,000-kW sets had had to be overrun and, owing to delay in getting the second 45,000-kW set commissioned, overhauling was unduly postponed. Consequently the wheels of one of the 20,000-kW sets failed, and was followed by the fracture of the h.p. steam casing (as indicated by the arrows in fig. 12) of the 45,000-kW turbine (1918) which, in the absence due to war conditions of steel, had been made of "semi steel." The reduction of the July peak load from 200,000 to 160,000 kW was managed in a magnificent spirit of co-operation on the part of 150 large consumers and the supply company. The day peak load was removed and replaced by evening and night shifts, after which the load was gradually allowed to increase again until November 1st, by which date it was again normal. Meanwhile, splendid work had been done by the station staff, and also by the contractors; a 20,000-kW set weighing 350 tons was removed and a 10,000-kW set installed in its place; the latter machine weighed 150 tons, and was erected in seven days while the speaker was in Detroit. The faulty 45,000-kW turbine was returned to its makers, and both it and the second set were in place again by November 1st. Fig. 11 showed the l.p. and generator end of the 45,000-kW (1918) set, while fig. 13 was a similar view of the 1920 machine with the former set behind it, and it would be noticed that the turbine casing of the newer machine had been heavily ribbed. As regarded the use of large sets, the speaker remarked that the peak of the Detroit Edison Co.'s load curve doubled every five years! At present 30,000 kW, of which size the Detroit Co. had two sets, was a

more fashionable size than the 45,000-kW one. Fig. 14 showed another type of large machine, a 60,000-kW (or on a two-hours' rating 70,000-kW) three-shaft set in which the steam divided from the high to the l.p. cylinders so that 60,000 kW could be developed by all three cylinders, or 40,000 kW by two of them. Should any one of the three machines fail it would be cut out automatically, and by means of other automatic valves boiler steam could be passed through a reducing valve on to either or both of the l.p. machines. That set was in one of the two New York stations of the Interborough Rapid Transit Co., one of the most interesting stations in America. The company originally used the "Manhattan" type of engine, which was used later by the London County Council at Greenwich. Some were replaced by two-spindle 30,000-kW machines shown in the background of fig. 14, the 60,000-kW set being in the foreground with its h.p. cylinder between the two l.p. ones; each set ran at a speed of 1,200 r.p.m., the l.p. turbines were of the double flow type, and the shaft between the two halves was provided with a labyrinth packing. In that connection the speaker mentioned an interesting accident that had occurred. After the machine had been in its maker's hands for some three months for overhaul, it was started up, and when it had run for three-quarters of an hour the shaft seized. It was fortunately tripped in eight seconds and pulled up almost "dead," otherwise there might have been extensive wreckage. Fig. 15 showed the extent of the damage, which was purely local, and fig. 16 was a more detailed view of the failure.

Mr. A. A. Carnegie was rather disappointed in the paper inasmuch as no test results of impulse machines had been included in it. The author had stated that only one result of such a test had been published, but the speaker recalled that he himself had given figures and information in the course of the discussion on Mr. I. V. Robinson's paper on "Power Station Design in Relation to Thermal Efficiency," on the occasion of the 1920 Convention of the Incorporated Municipal Electrical Association at Ilkley. He then exhibited steam consumption test curves of 20,000 and 10,000-kW Parsons turbo-alternators,* which tests were made after the machines had been in operation from one to thirty months, all with the same satisfactory results. The figures lay quite snugly along the line, and there was no deterioration even after the machines had been working for two years. Those results showed two things; first, that the efficiency obtained was not a matter of luck, and, secondly, that the method of testing could be relied upon, because it had been proved that the tests could be repeated with accuracy. The use of fine blade tip clearance was avoided in modern reaction turbines by the adoption of "end-tightened" blading, which made it possible to employ a radial clearance as large as desired.

Mr. R. A. Chattock thought that high speeds cut into the reliability of machines, and reliability was the first thing that the user considered. The thermo efficiency came next, but it must not be developed at the expense of reliability; he was of the opinion that they were justified in going to any reasonable expense to obtain reliability, and for the same reason gears should be eliminated as much as possible. Turbine makers would experience difficulties on account of the fact that generator manufacturers not infrequently required the machine to be run through its critical speed; however, whenever it was possible to do so they should keep within the critical speed. With regard to the erosion of turbine blading, the elimination of CO_2, &c., was very desirable, but in the speaker's opinion erosion was chiefly due to moisture in the steam itself, and he thought there would probably be more risk of erosion taking place in cases where high steam pressures were adopted. The speaker mentioned a certain bearing failure which had not been heralded in any way by an increase in the temperature of the lubricating oil; the cause of the failure had never been discovered, but he thought that such an accident could have been avoided by the use of temperature indicators, which would show the actual temperature of the metal itself and not that of the lubricating oil. In the case of large machines, two thrust bearings should be provided.

Mr. H. L. Guy, by the aid of lantern slides, considered the subject of the gain in heat consumption with increased pressure at different speeds a step further than the author had done.

Mr. S. E. Fedden considered that the paper had been very fairly written, and in connection with geared machines, mentioned that he had two such sets running for some two years: their consumption was guaranteed at 15 lb., but they operated regularly at ½ lb. less than that figure. How long could an impulse machine run without it being necessary to reblade it? However, he thought that the reaction type of blade obtained the best results so far as steam consumption and other factors were concerned. If the author's statement that "as far as efficiency is concerned, a turbine of 10,000-kW capacity running at 3,000 r.p.m., would be equivalent to a turbine of 20,000-kW capacity running at 1,500 r.p.m." was correct, it would appear from Mr. Carnegie's remarks that the 10,000-kW machine was the better one to use. He was glad the author did not agree with the by-passing of steam, because it was undesirable to pass steam from one part of the turbine into another for which it was not designed. They did not hear of any great catastrophes occurring to reaction turbines as to impulse type machines of both large and small capacities. The different manner in which various makers

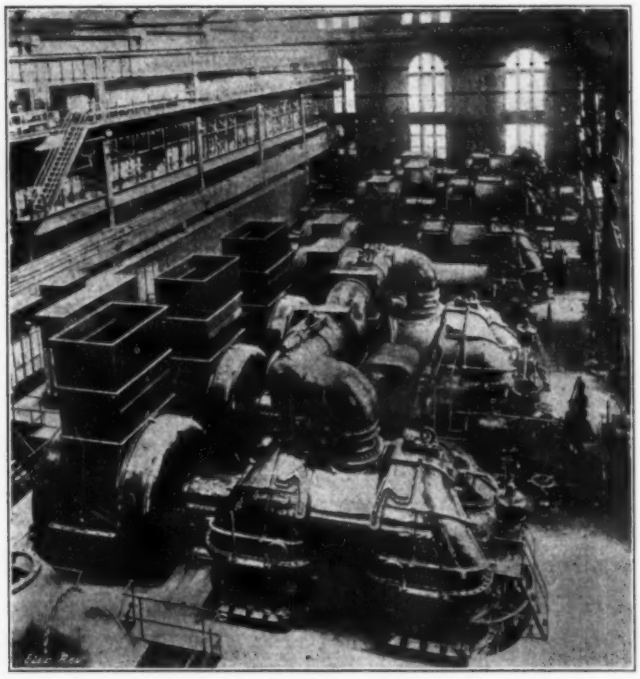


Fig. 14.—A 3-shaft, 70,000-kw. Set at New York.

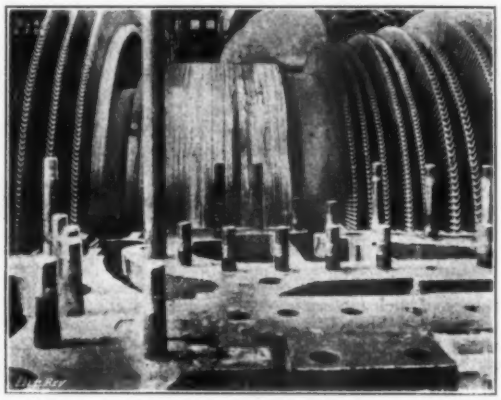


Fig. 15.—Labyrinth Packing Failure.

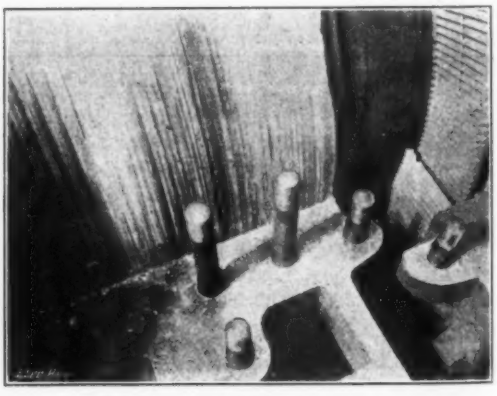


Fig. 16.—Labyrinth Packing Failure.

* Elec. Rev., July 9th, 1920, p. 39.

advised that turbines should be started up was puzzling, and the question appeared to be: Were they "progressing" at too fast a rate?

Mr. B. Pochobradsky pointed out that turbine development had proceeded in two classes; one, as in the U.S.A., adopted a large number of stages of small diameter, and the other just the reverse. On the Continent the practice was to increase the diameter as far as possible and reduce the number of stages, a policy which resulted from long research and experiment, and good results had been obtained. He did not agree with the author that turbine development had reached a critical stage. Accidents could generally be classified; for instance, those due to no provision having been made for expansion, to interruption of the oil supply, to small clearances, &c., were not new, and every form of heat engine had been subject to them from the earliest days. On the other hand, disk failures were "more modern" troubles, but they also could probably be avoided by more careful inspection of materials as they were passing through the shops.

Mr. A. Jude was of the opinion that the leaving losses were nothing like so important as the author appeared to imagine. Long blades were also very undesirable, and those who used them must expect to get trouble; they could, in fact, well afford to countenance some extra loss if by so doing they could reduce the length of the blades. The author's multi-exhaust system was a perfectly ludicrous affair; he appeared to have entirely overlooked the fact that the leaving losses were not confined to the last stage of the turbine, but that the last stage but one also had leaving losses.

Mr. R. J. Kaula appreciated the author's ingenious double exhaust idea, but thought that such like things were only what might be termed a "passing phase" of development, and that sooner or later they would return to the simple flow design. Meanwhile, the difficulty was to obtain some reliable disk material. Another problem was the nebulous subject of disk vibration in connection with which the speaker mentioned a case of disk failure in which a new disk of carefully selected steel was made, but did not reduce the vibration at all. As it was a special case where they could not afford to have the machine out of commission for any length of time they had had to adopt the remedy of making the disk strong enough to withstand the vibration instead of eliminating the cause of it. Later, however, when the case was more fully investigated, it was found that resonance had a considerable influence on the matter. Each pole change of the generator caused an impact on the shaft, however slight, which was transmitted along the shaft to the turbine disk.

Mr. A. B. Field pointed out that the machines tabulated in the author's first table illustrated American practice, whilst those in the second showed European practice which was due, he thought, to the different frequencies in use in the various countries. At the outbreak of the war manufacturers had anticipated being called upon to furnish sets of 50,000-kW capacity and over, but that demand for large individual machines had now entirely disappeared in Europe, at least for the present. In the U.S.A. conditions differed on account of the periodicity of 60 cycles per second used there. The author's statement that a 30,000-kW Ljungström turbine was in course of manufacture in America would have been equally true five years ago.

A PRACTICAL WAGE SUGGESTION.

[Issued by authority of the National Alliance of Employers and Employed.]

Much of the present industrial difficulty is due to the fear on the part of organised Labour—a fear carefully exploited by the unofficial extremists' movement within trade unionism—that employers are endeavouring to make very drastic cuts in wages at once.

Actually, specific instances of this are difficult to find. On the contrary, it can, with substantial accuracy, be stated that although the opportunity exists at the moment for employers to take advantage of the industrial situation, in the great majority of cases they are carefully refraining from doing so.

It is perfectly true that those who control the industrial situation can reduce the social system to chaos, and there is little doubt that, if organised Labour endeavours to retain all that it has obtained during, and since, the war, in the teeth of a falling cost of living; or if the organised employers use the weapons of international competition and unemployment, in an endeavour to force the workers' standard of life back, suddenly, to that of 1914, or even lower, social chaos will result.

The alternative is to meet not as opponents, but as partners, and agree to some general scheme whereby wages accompany the cost of living on the downward scale.

The economists allege that wages are a substantial cause of rising prices, and must fall before the cost of living falls, but in view of the fact that the cost of living has fallen from 179 per cent. to 141 per cent. without any marked drop in wages, the economist theory, though technically sound, is disproved by facts. The fall could be immediately reflected in lower wages, and the lower wages might then again be reflected in a lower cost of living, and so on.

One might illustrate by presuming that a craftsman's wage prior to the war was 11d. per hour, but that it has since risen to 2s. 3d. An agreement could be accepted on national lines that the 2s. 3d. should stand, down to the point of 150 per cent. in the cost of living.

After that for every drop of six points in the cost of living, averaged over a period of three months, the craftsman's hourly rate should drop ½d. as follows:—

Cost of Living Figure.	Wages.	Cost of Living Figure.	Wages.
150 per cent.	2/3d.	72 per cent.	1/8½d.
144 per cent.	2/2½d.	66 per cent.	1/8d.
138 per cent.	2/2d.	60 per cent.	1/7½d.
130 per cent.	2/1½d.	54 per cent.	1/7d.
126 per cent.	2/1d.	48 per cent.	1/6½d.
120 per cent.	2/0½d.	42 per cent.	1/6d.
114 per cent.	2/0d.	36 per cent.	1/5½d.
108 per cent.	1/11½d.	30 per cent.	1/5d.
102 per cent.	1/11d.	24 per cent.	1/4½d.
96 per cent.	1/10½d.	18 per cent.	1/4d.
90 per cent.	1/10d.	12 per cent.	1/3½d.
84 per cent.	1/9½d.	6 per cent.	1/3d.
78 per cent.	1/9d.	0	1/2½d.

These figures are merely used to illustrate the method, and can be changed for the different types of workers.

It is to be noted that at every point the cost of living would drop before wages fell, and would fall more than wages, and at each point the individual's real wages as expressed in purchasing power would be increased. When the cost of living reached the point at which it stood in 1914, his wages per hour would be 1s. 2½d. instead of 11d.—that is to say, his standard of life would have risen nearly 15 per cent.

The scheme is very far from being watertight. There is, for instance, the case of those trades in which the workmen received no rise in wages until the war had been on for two years, or even longer; it is not suggested that this scheme should be applied to them.

Then there are a series of trades in which wages, although they rose, did not rise to an extent commensurate with the rise in the cost of living. There are difficulties, too, produced by workmen receiving incidental rises, such as the 12½ per cent. which, apparently, had no relationship either to the cost of living or wage rates.

There is no doubt that there are a great many industries where, in an exact way, this scheme could not be applied, but the principle embodied in this scheme is one which, if carefully considered and amicably discussed by meetings of employers and trade unionists who have at heart the interests of the community rather than any narrow or personal motive, and if carried into practical effect, presents a method of negotiation in the face of present difficulties as an alternative to industrial strife.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Wire Connector.

From Mr. W. Quax, 80, Ashley Lane, Moston, Manchester, we have received particulars of an ingenious little device for connecting two, three, or four wires of small electrical circuits, as shown in the accompanying figures. This consists of four parts: A brass tubular member with axial slots at one end; a soft brass cap; a brass cap with two threads, one for screwing into the tubular member and one to fit the

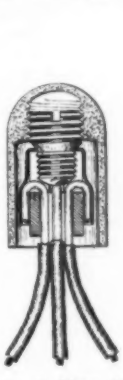


Fig. 1.—A New Connector. (Section.)

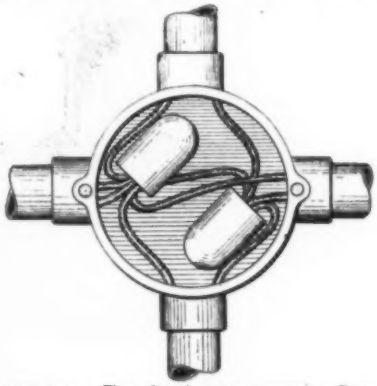


Fig. 2.—Arrangement in Box.

porcelain cover which forms the fourth part. When wiring, the ends of the wires are bared for about half an inch, and are pushed through the tubular brass member and bent over into the slots. The soft brass cap is then placed over the

wires, and the screw is fitted into the tubular member and screwed in tightly, when the brass cover will conform to the shape of the wires and clamp them in position. The porcelain cover is then placed over the whole fitting. This is a Dutch device, and is to be manufactured in England if the demand justifies this.

The "Nilfisk" Suction Cleaner.

Messrs. Gillespie & Beales, Amberley House, Norfolk Street, Strand, W.C.2, have sent us particulars of the "Nilfisk" suction cleaner (fig. 3), which is manufactured in four sizes. This consists of a cylindrical dust chamber above which is mounted a vertical spindle commutator motor having a two-stage turbine fan of special design mounted direct on the motor shaft. The motor and turbine are encased in a strong

Fig. 3.—The "Nilfisk" Suction Cleaner.

copper and nickel-plated steel housing terminating in a substantial base-plate. The motor is mounted on ball bearings. A filter is fitted which entirely cleans the air before it passes through the turbine, and the dust is retained in a cloth receptacle which may be easily removed and emptied. The ordinary accessories comprise 10 metres of flexible cable with the necessary adapters, 3 metres of suction hose—rubber-covered flexible steel coil—and six nozzles of different types for a wide range of uses.

The smallest type of "Nilfisk" cleaner weighs 17 lb. 7.7 kg), and has a consumption of 175 watts; the largest size weighs 51 lb. (23 kg), and consumes 600 watts.

Longitudinal Lighting Lanterns.

A short time ago Mr. Haydn T. Harrison brought out a new system of street lighting by means of special lanterns which direct their beams in a horizontal direction as opposed to the usual mode of distribution. These lanterns are made in various types, one of which can be adapted to existing

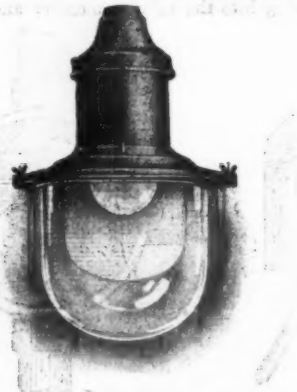


Fig. 4.—"Longitudinal" Street Lantern.

electric lighting globes shown in fig. 4, another which can be applied to the usual gas-light lantern, and a special "Canterbury" type.

The design is such that the lower hemispherical luminous flux from the light source is not interfered with, so that it fulfils its function of illuminating the immediate vicinity of the lamp. The upper half of the flux, which is generally wasted, or only partially used, is collected by a specially designed reflector into a solid angle of the desired divergence. This light would normally shine directly below the lamp, but in this system it is directed up and down the street by two or more plane mirrors. The angle of these mirrors is adjusted so that the light begins to fall on the road or street at the point where the direct light fails to bring the illumination up to the required standard, and increases in power until it meets the light from adjacent lamps; this ensures a more even illumination throughout and eliminates dark patches. The sole licensees for the manufacture of these lanterns are the General Electric Co., Magnet House, Kingsway, and the Electric Street Lighting Apparatus Co., The Foundry, Canterbury.

LEGAL.

James Pitkin & Co., Ltd., *v.* Aladdin Renew Electric Lamp Corporation, Ltd.

Mr. Justice Salter, in the King's Bench Division, on April 6th, commenced the hearing of this action. The claim was for damages in respect of an alleged breach of contract to pay for 20 special winding machines used for the purpose of renewing filaments of electric lamps, and failure to accept delivery of 46 other similar machines, the remaining portion of the contract to make 100 such machines.

The defence was a denial of the alleged breach and an affirmation that the contract was that the machines were to be delivered at the rate of 20 per month or as defendants might require them. Defendants said that on February 23rd they wrote to plaintiffs to defer delivery until they sent definite instructions as to destination. Defendants also put in a plea that the machines were defective, and they counter-claimed for damages, and asked for an injunction restraining plaintiffs from selling the machines to any lamp manufacturers other than the defendants.

Mr. Disturnal, K.C., for the plaintiffs, said they were well-known manufacturers of scientific and electrical instruments, and in 1919 they were approached by a company known as Seymour, Gordon & Co., to manufacture a number of machines for the purpose of winding the filaments of electric lamps. The company apparently had a scheme for the renewing of the filaments of lamps, and had an idea that plaintiffs would manufacture the machines for the purpose. Seymour, Gordon & Co. were also connected with a company called the Renew Electric Lamp Co., and they were now represented by the present defendants. It was not necessary, said counsel, that his Lordship should know the relationship between these three companies, because the contract that was ultimately entered into was disputed by the defendants. The action was brought to recover the price of 20 of these machines at £52 10s. per machine, and damages for refusal to take the balance of the machines arranged for under the contract. Thirty-four of the machines had been delivered and paid for, so that with the 20 additional there had been a total delivery of 54. As to the remaining 46, defendants had refused to take them, and plaintiffs accordingly sued for non-acceptance. Plaintiffs, in the course of the development of the machines had made certain inventions for which they took out provisional protection, and there was a dispute between the parties as to who had a claim to the patent rights. That dispute was settled by agreement, and one of the defences set up by the defendants was that the agreement had been broken by the plaintiffs. The plaintiffs said there was absolutely no foundation for that, it was entirely a misconception. He submitted that the contract meant that defendants should take delivery of the machines at the rate of 20 per month, or as defendants might reasonably require them; they were not entitled to put off delivery for ever if they liked. As to the defence that the machines were defective, counsel said that no suggestion of defects was made before the writ in the action was issued. They had, in fact, received and paid for 34 machines without any question.

Mr. R. L. Lee, managing director of the plaintiff company, gave evidence that the machines had been made and could have been delivered.

On the continuation of the hearing, Mr. Lee, in cross-examination by Mr. Watt, for the defence, said he obtained a provisional patent protection for everything included in the machine on December 10th, 1919. The nine months' grace for completing the patent protection had lapsed, and the specifications had not been completed. His firm was to have the right of selling the machine for purposes apart from refilling electric lamps. He thought the machine had possibilities for other purposes. His firm had introduced new devices, and they were entitled to a patent on those devices.

Mr. Watt: Then why did you let it lapse?

Witness: I came to the conclusion about June or July that it was not worth our while to spend money in patenting this. The defendant company objected to the firm patenting it on three grounds: First, they wanted other people to make it; secondly, some of the shareholders in the Aladdin Co. were

able to make it themselves, and would object to plaintiffs making it; and thirdly, the people in France would insist upon having it made in France. He would not agree to that. He was keen on keeping the whole thing, but as a concession he gave the defendants the power of renewing.

Witness was further cross-examined as to certain "advertisements" which it was said had appeared in the ELECTRICAL REVIEW in relation to the machine; he said he had never advertised, nor had he seen advertisements in relation to the machine—but it might have been commented upon by that journal in its news columns.

The case was continued on Friday, when evidence was given on behalf of the defendants relating principally to the terms of the contract and the construction of the machines and the alleged defects found in them.

Mr. COMPSTON, K.C., counsel for the defence, argued that in order to maintain an action for non-acceptance there must be proof of an agreement to deliver after the contract date, and in this case there was no such proof. The plaintiffs were not, he said, ready to deliver, and there was no evidence that a tender had been made. No damages could, therefore, be claimed. As to the patent question, he contended that there was no obligation to renew.

His LORDSHIP in the result reserved judgment until the report of experts had been received with regard to the machines and their alleged defects, for which purpose a period of fourteen days was allowed.

SHEPPARD *v.* GLOSSOP CORPORATION.

IN the Court of Appeal, before Lords Justices Bankes, Scrutton and Atkin on April 7th, the hearing was concluded of the case of Sheppard *v.* the Corporation of Glossop upon the appeal of the Corporation from the judgment of Mr. Justice Greer awarding the plaintiff, W. H. J. Sheppard, a carter, of Glossop, £279 10s. damages for personal injuries sustained by him owing to the alleged negligence or breach of duty of the defendants as the lighting authority for the district.

The facts were these: The plaintiff on the night of Christmas Day, 1918, after visiting a friend, was returning home at 11.30 p.m., intending to go there by Dun Lane and Mary Road. Dun Lane was a highway repairable by the defendants, as surveyors of highways. Mary Road was a public footway belonging to Lord Howard of Glossop, but had not been taken over by them as highway authority. For a considerable time there had been a lamp in Quarry Road placed above a retaining wall on Lord Howard's land. This place was dangerous to foot passengers on a dark night if the lamp was not lighted. The plaintiff, walking along Quarry Road, owing to the darkness, missed his way and got in front of the lamp and fell from the top of the retaining wall, fracturing his skull and receiving other injuries. The light in the lamp had been extinguished at 9.30 in pursuance of instructions of the defendants, who by a resolution previously passed by the Lighting Committee, had determined for reasons of economy that the lights in the borough should be extinguished at 9 p.m. Plaintiff accordingly brought the present action, with the result before stated.

Lord Justice BANKES, in giving judgment allowing the appeal, said the case raised a question of importance to local authorities outside the Metropolitan district. Plaintiff's case was that the defendants were liable to him in damages for the injuries he received owing to their failure to keep a lamp alight at a dangerous spot within their area. There was no doubt, said his Lordship, that the spot was a dangerous place, but so far as the evidence went not a dangerous place made dangerous by the Corporation. It was dangerous since it came into existence when it was carved out of the adjoining ground. Mr. Justice Greer had found that if the lamp had been alight the accident would not have happened. The first thing to consider was what was the statutory duty of the Corporation with regard to the lamp. The defendants' statutory authority for lighting the district was to be found in Section 161 of the Public Health Act, 1875. The true effect of that section was that it gave the defendants authority to light their district, but it created no obligation to light it, and gave the authority a discretion whether they would light only some portions of the district and as to when the lamps were to be kept lighted in any portion of the district which they elected to light. There was a great distinction to be found between the powers given to local authorities under that section and the powers given under Section 130 of the Metropolis Management Act, 1855. He had come to the conclusion that there was no authority to support the proposition that Section 161 of the Public Health Act created any obligation upon the lighting authority to light any portion of the district. The only cases where the local authority had been found guilty of a breach of duty was where the authority had themselves created the danger or put the obstruction in the highway. That was not so in the present case. It was not possible to establish that the defendants were under any duty to the plaintiff to keep the lamp alight, and in those circumstances the appeal must be allowed and judgment entered for the defendants, with costs.

The other members of the Court delivered concurring judgment.

UNLICENSED WIREMAN CHARGED AT MELBOURNE.

THE first prosecution under the rules for the "licensing of wiremen," as provided in the Electricity Commissioners Act, 1918, was held at the City Court, Melbourne, on February 17th, when F. P. Sawyer, senior clerk of the State Electricity Commission, charged G. E. Jobson, trading as Cooke and Jobson, electrical contractors, Ormond Road, Elwood, with having undertaken electric wiring in premises without having a licence to do so.

T. F. WHITELAW, inspector, Melbourne City Council electric supply department, gave evidence that he had inspected the work. He found a number of badly made joints, which were not covered, and were a source of danger.

In answer to the presiding magistrate, witness said that faulty work was a cause of fire. He was of opinion that defendant was not capable of carrying out the work.

For the defence it was stated that defendant was a minor, but had had a fair amount of experience. He was not a licensed man, but did not carry out any work unless accompanied by his partner, S. A. Baldwin, who held a permit as a vocational trainee under the Repatriation Department.

The presiding magistrate said that the evidence of the inspector showed that defendant was not only working without a licence, but that he was not capable of doing the work. These rules had been made for the protection of the public, but as this was the first case the bench would only impose a small penalty.

Defendant was fined £2, with costs.—*The Age* (Melbourne).

BUSINESS NOTES.

Bankruptcy Proceedings.—CHARLES THOMAS STANTON, trading as The Southern Electric Engineering Co., 25, Beckenham Road, Penge, and 5, Laurel Grove, Penge, Kent, electrical engineer.—The first meeting of creditors was held last week, at the offices of the Official Receiver, 132, York Road, Westminster Bridge Road, S.E., under the presidency of Mr. Thomas Gourlay. According to the statement of affairs, the liabilities amounted to £1,166, of which £1,116 was expected to rank. The net assets are £123, or a deficiency of £993. It appeared that the debtor was for 17 years in the engineering branch of the Post Office Telephone Service, and started business for himself as an electrical engineer, in partnership, in March, 1919. He commenced without capital, and his partner brought in about £10 and £40 was borrowed and is still owing. The partnership was dissolved last July, and was duly gazetted. The debtor then continued the business, and last November an agreement was entered into for another man to enter the concern and to find £300 for a half share. The sum of £200 was actually brought in, but the person finding the money was dissatisfied and withdrew. He was given a receipt for £200, which the debtor undertook to repay by quarterly instalments of £30 each. Recently the debtor was continuously pressed by creditors, two executions were levied by the Bailiff of the Croydon County Court, and he filed his own petition. He attributed his present position to "want of capital, depression in trade, high cost of labour and material and pressure by creditors." The Official Receiver said the best course would be for someone to buy the business if they had any faith in it. There was no reserve of assets to allow a trustee to run the business. He was afraid the assets would not produce much more than £100 after providing for the preferential claims. No resolutions were passed, and the matter remains in the hands of the Official Receiver. The following are creditors:—

Pancho Cigar Co.	£324	Evans	£90
Allum, S. J.	200	Taylor, D.	23
Simplex, Ltd.	89	Express Electrical Co.	20
Ankers, T.	50	Corris	25
Williams, W. R.	29	London Electrical Co.	20
Taylor, C. W.	30	Metropolitan-Vickers Co.	23
Cocking, S.	30	Morris, E.	13
Cocking, N.	20	Beckenham Electric Supply Co.	16

R. C. JONES (Electro-Magnetic Engineering Co.), of 10, Caledonia Street, King's Cross, N., and 59, Longridge Road, Earl's Court.—Receiving order made March 30th, on creditor's petition. First meeting was held on April 13th; public examination, June 3rd, at Carey Street.

J. C. THOMSON, electrician, lately electrical engineer and contractor, Mansfield, Notts.—First and final dividend of 11s. in the £, payable April 20th at the Official Receiver's offices, 4, Castle Place, Nottingham.

W. H. WOOD, electrical engineer, Birmingham.—Trustee (Mr. J. W. Blackham, 147, Corporation Street, Birmingham), released March 18th.

A. S. PALMER journeyman electrician, Margate.—Trustee (J. O. Osborne, 68A, Castle Street, Canterbury), released April 4th.

J. JAGGER (J. Jagger & Co.), electrical engineer and contractor, Halifax.—Trustee (Mr. A. Gray, 9, Fountain Street, Halifax), released March 18th.

ALBERT EDWARD DICKINSON, trading as Crown Electrical Co., 157, Hunslet Road, Leeds, electrical engineer and contractor.—The following are creditors :—

Casperson, George	£13	Jennings, Wm.	£183
Calmont King & Co., Ltd. ..	61	Milne & Son, Ltd.	67
Drake & Gorham, Ltd.	40	Manchester Lighting Co.	14
English Electric and Siemens Supplies, Ltd.	10	Smith, Burkby & Co.	17
Forman & Sons	15	Williamson, Jos.	97

W. DRYSDALE, electrician, Barrow-in-Furness.—First dividend of 9s. in the £, payable April 23rd, at 4, Ramsden Square, Barrow-in-Furness.

Dissolution of Partnership.—THE PRIMOVER POWER Co., electrical and mechanical engineers, 364, Humberstone Road, Leicester.—Mr. G. E. Purdy and W. H. French have dissolved partnership. Mr. W. H. French will attend to debts.

Company Liquidations.—ORIZABA TRAMWAYS SYNDICATE, LTD.—Winding up voluntarily. Liquidator, Mr. A. F. Dickin, Sardinia House, Sardinia Street, Kingsway, W.C.

ANGLO-FOREIGN TRAMWAY SYNDICATE, LTD.—Winding up voluntarily. Liquidator, Mr. A. F. Dickin, Sardinia House, Sardinia Street, Kingsway, W.C.

ELECTRIC SUPPLY COMPANY OF WESTERN AUSTRALIA, LTD.—A meeting is called for May 9th, at 225, Royal Liver Buildings, Liverpool, to hear an account of the winding up from the liquidator, Mr. G. Saies.

GENERAL INSTRUMENT AND ENGINEERING CO., LTD.—Winding up voluntarily. Liquidator, Mr. W. J. Maxwell, 56, Moorgate Street, E.C. Meeting of creditors is called for April 21st.

SEMAPHORE ENGINEERING CO., LTD.—Winding up voluntarily. Liquidator, Mr. H. W. MacLaren. Meeting of creditors held April 14th.

NORTH BRITISH ELECTRIC WELDING CO., LTD.—Meeting called for May 19th, at 30, George Square, Glasgow, to hear an account of the winding up from the liquidator, Mr. W. Gilchrist.

Trade Announcements. — The Greengate and Irwell Rubber Co., Ltd., Greengate Works, Manchester, have appointed MESSRS. WAKEFIELD, WILLIAMS & Co., Richmond Road, Bradford, to be their agents for Yorkshire.

MR. J. B. RUDKIN, of 212A, Shaftesbury Avenue, London, W.C., has been appointed representative in Great Britain for Sprecher and Schuh Co., electrical apparatus manufacturers, of Aarau, Switzerland, for the sale of their apparatus.

Messrs. Ferguson, Pailin, Ltd., have appointed MR. W. WALLWORK, of Station House, West Boldon, Durham, as their representative in the North-East Coast district.

Messrs. Hogan & Wardrop have appointed MR. ALEXANDER MORRISON, of 12, Waterloo Street, Glasgow, as agent for Scotland, and the CASTLE ENGINEERING CO., LTD., Church Street, Eccles, to represent them in Lancashire.

The Delta Electrical Co., of Temple Courts, Temple Row, Birmingham, has changed its name to THE Y SWITCHGEAR CO. The change has been made by mutual arrangement with another company of similar name, in order to avoid confusion, but there will be no change whatever in the constitution and conduct of the business.

The telephone number of the TWISS ELECTRIC TRANSMISSION, LTD., has been altered to "Victoria 7625."

New showroom premises at 11, Earl Street, Maidstone, have been opened by MR. WM. COGGAR, electrical engineer.

MESSRS. NETTLEFOLD & SONS, LTD., of High Holborn, inform us that Mr. D. M. Edwards, who has been appointed representative to Messrs. Baxter & Caunter, Ltd., was formerly their representative for electrical conduit tubes and fittings, and not manager, as stated in these "Notes" last week.

Catalogues and Lists.—MESSRS. DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre. W.C. 2.—Leaflet No. 309, an illustrated price-list giving details of a new 30 volt bowl fire.

MESSRS. COPUS & GREEN, 22, Clapham Road, S.W. 9.—Two illustrated leaflets describing the "Aqua" electric water heater.

ENGINEERING AND COLLIERY APPLIANCES, LTD., Sheffield.—Two illustrated and priced leaflets describing patent tachometers and patent hand tachometers and cut meters.

THE PHOTECTOR CO., LTD., Central Hall, Southall.—An illustrated pamphlet describing asbestos-woven resistance nets and grids and their application.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., 20, Brazennose Street, Manchester. — Leaflets Nos. 64 L/1—1 and 64 L/1—3, describing and illustrating type "F" high-pressure contactors for controlling live circuits; Leaflets No. 64/12—1 and 64/12—3, dealing with automatic contactor-type star-delta starters for three-phase non-reversing squirrel-cage motors.

MAGIC APPLIANCES, LTD., 151-159, Westminster Bridge Road, S.E. 1.—An illustrated price-list of the "Magic" suction cleaner, the pioneer British self-contained suction cleaner, which has been entirely re-designed.

THE Y-SWITCHGEAR CO., Temple Courts, Temple Road, Birmingham. — Publication No. 100 B, an illustrated leaflet giving prices and descriptions of watertight tumbler switches in various styles.

Polish Commercial Activities.—Reuter's Agency learns from a Polish source that the Ministry of Trade and Commerce in Warsaw jointly with the Ministry for Foreign Affairs is pushing forward preparations for the conclusion of Commercial Treaties with Great Britain and Italy.

A Rumanian Trade Delegation is also expected to arrive in Warsaw shortly.—*Reuter.*

Correction.—An error occurred in the advertisement of the Z Electric Lamp and Supplies Co., Ltd, appearing in our issue of April 8th. For £17 10s., read £15, as in the advertisement of April 1st.

Book Notices.—Mr. W. H. Warren, Wh.Sch., has revised his "Engineering Construction—in Steel and Timber"—the third edition of which is now ready, price 30s. net, and will in future be known as Part I of his work. He has also written a new volume to be called "Engineering Construction Part II—in Masonry and Concrete," which will be ready shortly, price 36s. net. Both volumes are published by Messrs. Longmans, Green & Co.

"Education for Industry." (42 pp. illustrated.) Manchester: Metropolitan-Vickers Electrical Co., Ltd.—This is a very full description of the apprenticeship schemes which are in operation at the company's Trafford Park works, and the more advanced schemes for aiding post-graduate research students. Details are also given of the works training provided for students during their long summer vacation, special courses for women, and particulars of research scholarships, &c.

"*Transactions* of the South African Institution of Electrical Engineers." Vol. XII, Part 2. February, 1921. Price 2s.—In this issue are recorded the new President's inaugural address, and discussions on papers "Notes on Commutators," and "Notes on Small Suction Gas Plants," &c.

"The *Journal* of the South African Institution of Engineers." Vol. XIX, No 8. March, 1921.—The papers printed in this issue are: "A Contribution to the Study of the Influence of Mine Atmospheric Conditions on Fatigue," by A. J. Orenstein, C.M.G., M.D., and H. J. Ireland, M.B.E., and "Scheme for Working the City Deep Mine at a Depth of 7,000 ft.," by E. H. Clifford.

"Relativity and the Electron Theory." By E. Cunningham, M.A. (148 pp.) London: Longmans, Green & Co. Price 10s. 6d. net.

"Technology," the *Journal* of the Manchester Municipal College of Technology, Vol. X. (170 pp. and figs.) Manchester: The College.—Included among the papers presented in this volume of the *Journal* is "Dynamo-Electric Machinery, 1878-1916," by Prof. Miles Walker, M.A., M.I.E.E. This is a review of a branch of engineering which has undergone vast development, and in a relatively small space Prof. Miles Walker has contrived to deal with his subject in a very comprehensive manner. Other papers are "Part-time Secondary Education," by the Principal; "Cast-Iron: the Strength and Properties of Castings," by Mr. E. L. Rhead; "The Distribution of Frictional Losses in Internal Combustion Engines," by Mr. E. P. Taylor, and "Trisecting an Angle," by Prof. W. W. Haldane Gee, B.Sc., and Mr. Arthur Adamson.

"Electrical Engineering." By T. F. Wall, D.Sc., &c. (pp. 491, figs. 463). London: Methuen & Co., Ltd. Price 21s. net.

Inquiry.—The name and address of the manufacturer of the "A.B.C." electric washing machine are required.

Australian Association of British Manufacturers and their Representatives.—After four years of strenuous work as chairman of the Australian Association of British Manufacturers and their Representatives, Mr. Walter A. Purdom, has now relinquished office through pressure of other work. Great strides have been made in the activities of the Association in the period of his chairmanship, although there remains ample scope for a continuation of his record of achievements in the coming years. The chief aim of the Association—the expansion of British trade with the Commonwealth—is being pursued indefatigably from year to year, but as Mr. Purdom recently pointed out in his speech on his retirement from office the exports of the United Kingdom to Australia are still far short of what they should be. While the Association fully recognises that Australian industries deserve whole-hearted support, there are still large quantities of goods from non-British countries coming into the Commonwealth, and it is for securing a greater share for British goods that the Association's efforts are directed. The Association has an office in London at 32, Victoria Street, S.W. 1, and United Kingdom manufacturers and merchants interested in Australian trade should maintain touch with it for purposes of guidance and information. Copies of the Association's "All-Red Directory" can also be obtained from the London office. This contains a complete list of members—manufacturers and agents—together with the goods they manufacture or handle.—*The Board of Trade Journal.*

Fuse Wire Table.—MESSRS. P. NUTTER & SON, 41, Side Newcastle on-Tyne, have just issued a table giving the fusing currents of tin and copper wires ranging from 8 to 47 S.W.G.

A Liverpool Electrical Exhibition.—MESSRS. JAMES SCOTT, of the Knowsley Electricity Works, Bootle, are holding an interesting exhibition of electrical appliances in the Liverpool Exchange News Rooms this week. An interesting feature of the exhibition is Messrs. Scott's patent fire alarm, which is calculated to be of excellent service in giving prompt notification of an outbreak of fire in big buildings, such as hotels, &c., and in ships. An indicator is placed in a certain position in a ship or building, to which every bell is connected with its corresponding number shown on the indicator, so that when a fire occurs, its position is made apparent immediately.

Copper and Lead Prices.—MESSRS. F. SMITH & Co. report, April 12th:—Copper (electrolytic), bars, sheets, and wire rods and h.c. wire, no change.

MESSRS. JAMES & SHAKESPEARE report, April 12th:—Copper bars (best selected), sheet and rod, no change. English pig lead, £22 5s., an increase of 15s. on last week's quotation.

For Sale.—York Corporation Electricity and Tramways Committee has for disposal two Willans-Dick, Kerr 500-kW. d.c. generating sets, with Allen surface condenser, pumps, control switchboard, &c.

Burnley Corporation Electricity Department invites offers for one 250-kW triple-expansion Belliss-Dick, Kerr generating set, with condensing plant, also one Lancashire boiler, with superheater and Bennis stoker.

Ashton-under-Lyne Corporation Electricity Department has for disposal generating plant, including one 75-kW and one 300-kW motor-generator, one 400-kW turbo-alternator, and one Lancashire boiler, &c. By direction of the disposal board, Messrs. Fuller, Horsey, Sons & Cassell will sell by auction, on April 28th, at the Thames Iron Works depôt, Greenwich, surplus electrical plant, &c.

For particulars, see our advertisement pages to-day.

Toronto Exhibition.—H.M. Trade Commissioner at Toronto has drawn attention to the Canadian National Exhibition—an annual event there—which is this year to be open from August 27th until September 10th. The Commissioner recommends the Exhibition as presenting a very good opportunity for United Kingdom firms to secure wide publicity for their products in Canada. It combines the features of a trade fair and a pleasure ground. Many of the more important Canadian and American firms are exhibitors, but the display by United Kingdom firms has hitherto been inconsiderable. At the 1920 Exhibition the number of United Kingdom firms represented was less than 30. Last year the attendance exceeded one million. As in former years, a Bureau of Information in connection with the Trade Commissioner Service in Canada will be maintained, and Mr. F. W. Field, H.M. Trade Commissioner at Toronto will be glad to receive any trade literature or catalogues for distribution, free of charge, from the Bureau in question. Small exhibits, typical of United Kingdom industries, and small attractive posters, will also be welcome. The catalogues, &c., should be sent direct to His Majesty's Trade Commissioner, 257-260, Confederation Life Buildings, East Queen Street, Toronto, not later than July 15th. Firms interested can obtain some further information from the Department of Overseas Trade in London, and applications for space should be sent at the earliest possible moment to the Secretary, Canadian National Exhibition, 38, King Street East, Toronto, Ontario, Canada.

German Electric Companies in Sweden. — With reference to the paragraph appearing under this heading in our issue of March 11th, we have received a communication from Osram G.m.b.H. Kommanditgesellschaft, of Berlin. It appears that the new company formed in Stockholm was founded by the Swedish Siemens-Schuckertwerke and the Stockholm A.E.G., and that it does not concern itself with the manufacture of glow lamps. The company is stated to be engaged exclusively in the sale of the manufactures of the Osram Co., of Berlin, referred to above, and it bears the name "Osram A.B."

Foreign Trade.—March Figures.—The following are the values of imports and exports of electrical goods and machinery in March :—

	March. 1921.	*Inc. or dec.*	3 months, 1921. *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c.	225,409	+ 146,581	+ 203,328
Machinery	1,295,649	+ 96,110	+3,882,506
Electrical machinery	71,853	+ 14,371	− 8,887
Exports.			
Electrical goods, &c.	1,155,718	+ 203,328	+1,302,386
Machinery	7,299,698	+3,882,506	+11,864,097
Electrical machinery	417,153	+ 266,762	+ 797,768
Re-exports.			
Electrical goods, &c.	30,324	+ 24,056	+ 65,118
Machinery	88,693	− 47,724	− 4,886
Electrical machinery	2,144	− 1,702	+ 6,243

Women's Wages Conference.—Unions represented at the conference at York, on April 8th, with the engineering employers on the subject of women's wages in the industry, declined to accept the new rates proposed by the employers, and adjourned to report on the position to their executives and members. The proposed rates provide for a basic rate, to which would be added an amount fixed for the cost of living and subject to quarterly fluctuations, according to the cost-of-living figures. They would give figures of 32s. per week for women of 18, with increases up to the age of 21 rising to 36s. Overtime and piecework would be calculated on the basic rate.—*Daily Dispatch.*

Cable Manufacturing in Holland.—The report for 1920 of the N.V. Nederlandsche Kabelfabriek, of The Hague, states that no difficulties were experienced in obtaining raw materials, and that after the reduction in the prices of the latter, the wages now formed a much higher percentage of the value of the finished product than formerly. The new machine shop was approaching completion; one of the lead presses had already been delivered and erected, and the second was ready, and was being dispatched by the makers. The rolling mill which was started in the summer had already contributed towards the possibility of completing orders within the stipulated period. As a proof of the confidence manifested in the company's manufactures, the report mentions the receipt from the Amsterdam Municipal Electricity Works of an order for 10 cables for 10,000 volts, of a total weight of 185 tons, which was finished, and the cables were laid in the Ij in August, 1920, so as to connect the Northern generating station with the Southern central station. The accounts show gross profits of 1,577,000 florins, of which 596,000 florins has been written off for depreciation of machinery, buildings, &c., and 30,000 florins allotted to the reserve fund for provident purposes. The balance then remaining, together with the amount brought forward, permits of the payment of a dividend at the rate of 23 per cent., as compared with 34 per cent. in 1919 on share capital of 1,250,000 florins. The share capital was increased to 2,500,000 florins, by means of a new issue made in July, 1920.

Careless Packing. — A correspondent writes :—"A leading trade association is considering the advisability of asking similar bodies to co-operate in a movement to secure the more efficient packing of goods of every description. The need is suggested by a statement made to the association by a carrying company that from December, 1919, to November, 1920, they received over one million claims for loss and damage. It is pointed out that in starting consignments aright it is important to determine, as regards many articles, what type of box to use and how it should be constructed. Dispatch clerks and shipping clerks should be instructed to see that all boxes are properly closed. Poorly assembled or improperly closed receptacles do not give their maximum service. A slight fall or jolt will break them open and expose the contents to damage and theft. Much damage also results from failure to prevent goods from moving about in the package. Movement means injury and breakage. Many firms have found it an advantage to have boxes made to proper size, and invite the box manufacturer to study the nature of the article and how it is disposed for shipment. The contents should, whenever necessary, be protected by bracing or by using "fillers" for open spaces. To reduce the pilferage evil, it has been suggested to the Manchester Association of Importers and Exporters that goods, such as textiles, hosiery, boots, &c., might be packed in wire netting and then made up into cases and bales as usual. The Council of the Association, however, considers that this plan would mean the payment of extra duty, as in some countries duties are charged on the gross weight, that there would be a possibility of valuable goods being torn by the wire netting or spoiled by rust, and that on the whole the suggestion is impracticable. Another plan recommended to the Association is to have bales cross-hooped with a view to checking the extraction of articles that do not go the entire length of the bale. This scheme is to be given a trial, and bales so hooped are to be watched, especially at East African ports, where numerous thefts occur."

Response to Emergency Call.—Nearly 400 men registered as electric train drivers in the Middle Classes Union attended an instructional class in London on April 8th. They attended in response to a call sent out a short time before. "Quite 4,000 of our members are registered as electric motor drivers," said an official of the Union. "Mr. Shortt, the Home Secretary, asked if we could supply any electric power station workers, and the authorities were very surprised when we found within a very short time 14 fully qualified power station controllers. We have every kind of engineer ready and waiting to take on voluntary duties."—*Daily Mail.*

Russo-German Trade Treaty.—The *Morning Post* of April 7th stated that it was reported that the signature of a Russo-German Consular treaty, corresponding to the commercial agreement between Great Britain and Russia, was imminent, the draft being under the consideration of the Soviet Government.

Germany recognises no loss or diminution of the rights of German citizens having industrial or other investments in Russia. Under the treaty German capitalists and others having property rights in Russia will be enabled to return to Russia or send their agents thither to take over their properties and where there are industrial establishments to restore normal working arrangements, and generally the treaty provides for the renewal of commercial relations between the two countries.

Burning Waste Fuel Dumps.—In view of the grave prospects of a prolonged strike on the part of the miners, and the possibility of difficulties of transport, the question of adopting means for burning substitutes for coal has again assumed importance. On the last occasion of a shortage of coal, large quantities of combustible refuse were successfully utilised by electricity works managers in place of coal, and doubtless there are many dumps of such material in industrial districts which are still available for use if necessary.

As explained in our description of the Wolverhampton electricity works (July 30th, 1920), during the war Mr. S. T. Allen, borough electrical engineer, succeeded in burning anything that was combustible by means of a combination of Underfeed stokers with forced and induced draught, and a special "Dutch-oven" furnace, without producing smoke. The "Turbine" furnace which we described in our issue of November 5th, 1920, has also been shown to be capable of burning waste fuel and rubbish which cannot be dealt with on the ordinary grate, and it can be fitted to existing boilers in a few hours.

Amalgamation of French Steel Companies.—The Paris edition of the *New York Herald* reports that three of the largest steel concerns in France are combining to form a new holding company. The Société Anonyme des Forges et Aciéries du Nord et de l'Est is to increase its capital from 46,000,000 to 86,000,000 fr., and will absorb the Société des Forges et Aciéries du Nord et de Lorraine and the Usines Metallurgiques de la Basse-Loire. The new combine will control an ore domain capable of producing 4,000,000 tons, six French coal companies and important coal deposits in England.—*Reuter's Trade Service* (Paris).

New French Companies.—The Société d'Electricité de la Région de Dunkerque is the name of a company formed, with 5,000,000 fr. capital, to carry out all kinds of operations relating to electricity, air, water, gas—their production, transformation, and installation. The offices are at 10, Rue Mogador, Paris.

Under the style of Société des Grandes Réseaux Electriques has been formed at Paris (8, Rue Lammenais) a company for the planning, construction, and installation of electric networks, and their accessories for the transmission, transformation, and distribution of electrical energy. Its capital is 1,000,000 fr. in 500-fr. shares.

Union to "Register" Contractors.—At a meeting of the Swansea Corporation Electricity Committee a letter was read from the local branch of the Electrical Trades Union stating that the time was now opportune for establishing a definite list of *bonâ fide* contractors, the reason being that serious complaints had been received of faulty installations by local employers and unskilled workmen, with the result that occupiers ran the risk of fires breaking out on their premises. The Union was, therefore, determined to set up a list of contractors, which would be duly advertised as and from July 1st next. Councillor Colwill pointed out that the Corporation already observed the Fair Wages Clause in all its contracts, and it could do no more. The Committee decided to take no action with regard to the Union's letter.

Board of Trade Committees.—The *Board of Trade Journal* gives a list of the Board of Trade Committees which are at present in being. The following are included :—

Committee.	Secretary.	Headquarters.
Electrical Communication with Lighthouses Committee.	R. H. Haylett.	Great George Street, S.W. 1.
Miners' Lamps Committee.	E. G. Fudge.	46, Victoria Street, S.W. 1.
Spontaneous Combustion of Coal in Mines Committee.	J. A. Kilpatrick.	46, Victoria Street, S.W. 1.
Water-Power Resources Committee.	T. Turner.	Great George Street, S.W. 1.
Water-Power Resources of Ireland Sub-Committee.	Prof. H. H. Jeffcott.	Royal College of Science, Dublin, Ireland.

Reduction in South African Railway Rates.—The South African Railway and Harbour Administration announces that, as from Wednesday, April 6th, a reduction of 6s. 6d. per 2,000 lb. has been made on railway rates for bunker coal to Union Ports and Delagoa Bay. The reduction applies to all coal placed in the bunkers on or after April 6th. No alteration will be made in the existing net railway rates for export cargo coal and industrial coal. The foregoing gives a total reduction of 15s. 5d. per 2,000 lb. on the railway rates in force prior to February 7th, 1921.

German Price Reductions.—The Price Bureau of the Central Union of the German Electro-Technical Industry has made a further reduction in quotations, those for machines and transformers having been brought down on an average about 15 per cent. The selling prices of other products have also been slightly reduced. Prices for smaller and medium machines are now nearly 50 per cent. under those prevailing when the market was at its height.—*Reuter's Trade Service* (Berlin).

Italian Bill to Abolish Monopolies.—The *Tribune* understands that the Cabinet has approved a decree abolishing the monopolies in coffee and electric lamps, and suppressing the Bureau of Trade Monopolies. The revenue lost as a result of the changes will be replaced by Customs or excise duties. It is hoped that the revenue thus accruing to the State will surpass that at present received from the trade monopolies.—*Reuter's Trade Service* (Rome).

English Electric Factories for Canada.—It is reported that factories will be built in this city by the English Electric Co. which will compete on a large scale with the United States concerns, on whose Canadian branches Canada has so far relied for her supply of electrical machinery and equipment.—*Reuter's Trade Service* (Toronto).

According to the *Canadian Electrical News*, Mr. Gordon F. Perry, the President of the National Iron Corporation, Ltd., is chairman of the Canadian Board of the English Electric. Mr. Perry has been in England recently arranging the details, and manufacturing in Canada is expected to start at an early date.

LIGHTING AND POWER NOTES

Aberdeen.—Electric Lighting Scheme Abandoned.—The proposal to use electricity instead of gas for lighting King Street has been dropped owing to the excessive cost, which was stated to be £756.

Extensions.—It is not now expected that a public inquiry will be required in connection with the Aberdeen Corporation Provisional Order, 1921, dealing with the proposed extension of the electricity works and the construction of a railway to connect the Caledonian goods yard with the electricity works, as there has been a withdrawal of the petitions objecting to the Order.

Ashford (Kent).—Proposed Electric Lighting Scheme.—At a meeting of the Urban District Council on April 7th, the Lighting Committee reported that as a result of the recent canvass to ascertain the probable number of consumers of electricity, only 83 residents had agreed to take electricity unconditionally. No further action was taken in the matter.

Barrow.—Proposed New Power House.—At the monthly meeting of the Town Council, on April 4th, the Electricity Committee reported that it had authorised the appointment of a small deputation to meet Messrs. Vickers, Ltd., with regard to obtaining a proposed new power house.

Blackburn.—Sub-Station Site.—The Parks Committee has decided not to allocate any portion of Brownhill Park for the purpose of the erection of an electricity sub-station.

Applications for Supply.—The Electricity Committee has received applications to extend the supply of electricity from the new station to Oswaldtwistle, Clitheroe rural district, Ramsgreave, Accrington, and Samlesbury. The Committee is already committed to supply Great Harwood, Rishton, and Darwen, and the new applications have been deferred.

Bradford.—Projected Expenditure.—The proposed expenditure of the Electricity Committee includes mains, stores, and offices and transformer test-room at Canal Road, £8,600; motor lorry shed, mess-room, blacksmith's shop, new offices and lavatories at Valley Road works, and roof over storage tank, £19,215; Blakehill quarry, £4,150; two 500-kW rotaries and switchgear; caterpillar crane and grab, £2,970; accumulator battery, £11,000; motor generator, £505; and radial drilling machine, £1,460.

Bridlington.—Loan Sanctioned.—The Corporation has received from the Electricity Commission formal sanction to the borrowing of £4,500 for mains and services in connection with the electricity undertaking.

Cannock.—Electricity Guarantee.—The Rural Council has agreed to guarantee to the Wolverhampton Corporation £130 per annum for three years, for the supply of electricity to 40 houses at Bushbury.

Chile.—Water Power Statistics.—From a survey recently made by a department of the Ministry of Public Works in Chile, it appears that the available water power in the Republic amounts to more than 4,000,000 h.p. This is an underestimate, as data regarding many rivers and watercourses are absent, and the total may be safely increased by 1,000,000 h.p. Of this total, concessions have been granted for 1,383,000 h.p., of which only 63,780 h.p. is being utilised for industrial purposes. In view of the fact that the mining industry, ironworks, &c., employ coal to produce motive power equal to 301,000 h.p., and that the railways consume 300,000 tons of coal to produce 100,000 h.p., there is an obviously strong case made out for legislation to enforce the better utilisation of the country's water resources, and more especially because of the high cost of coal at the present time.—*Boletin de la Sociedad de Fomento Fabril.*

Darlington.—Electricity Undertaking and Rates.—Alderman W. E. Pease, moving a rate of 13s., on April 7th, said the profits on what should be profit-earning departments were low, but he wished ratepayers to realise that though they were paying a high rate, they were getting water, gas and electricity at extraordinarily cheap rates. Alderman Wooler, who objected to the amount of the rate, said the costs of gas and electricity should be reduced to the lowest point, as it was unfair to derive profits by municipal trading.

Doncaster.—Opposition to Company.—The Electricity Committee, last week, received notice from the Adwick-le-Street Urban District Council of intention to oppose an application by the Electrical Distribution of Yorkshire, Ltd., for an order authorising it to supply electricity in the rural districts of Thorne and Doncaster and the urban district of Adwick. The Committee decided to recommend opposition to the company's application for power to supply in the area of the proposed North-East Midlands Electricity District.

Dover.—Supply to Lighthouse.—It was reported recently that Trinity House had declined to accept the terms offered by the Electricity Committee for a supply of electricity to the South Foreland lighthouse, and the engineer was instructed to submit alternative terms previously suggested, viz., Trinity House to find half of the estimated capital cost of the extension (£2,000), and pay for electricity at the rate of 10d. per unit for the first 5,000 units, and 5½d. per unit thereafter, with a guaranteed minimum of 15,000 units, which would produce £437, the Corporation to lay the necessary main and to supply a transformer, and to reserve the right to make additional connections at any point along the route.

Dublin.—Street Lighting.—Owing to the operation of the military "Curfew" order, it is proposed that only one street light in three shall be used.

Eastbourne.—Proposed Extensions.—At a meeting of the Town Council, the electrical engineer submitted details of a scheme for the extension of plant and mains, at an estimated cost of £65 443. Consideration of the report was postponed.

Electricity District.—Aire and Calder Inquiry.—The inquiry by the Electricity Commissioners into the three rival schemes in respect of the West Riding (Aire and Calder) Electricity District, which was to have been opened at Leeds on

Tuesday, has been postponed to a date to be fixed when industrial conditions are more settled. The Town Clerk of Bradford (Mr. N. L. Fleming), as solicitor to the Conference of West Riding local authorities who promoted the Bradford Conference scheme, received notice of the postponement on Friday, the Commissioners deeming it inexpedient to commence the inquiry under the present uncertainty of conditions.

Hereford.—Loan Sanctioned.—The Town Council has received sanction to a loan of £34,750 for mains, sub-station, transformers, &c., in connection with the supply of electricity in the Ross and Lydbrook areas.

Hove.—Converting Plant.—The Electricity Committee has approved the purchase of another 300 kW converting set, similar to two already installed. The purchase of a spare armature was also sanctioned. The new set will be employed as a stand by for use in the event of the other sets being overloaded.

Hoyland Nether.—Transfer of Order.—The Urban District Council has applied for powers authorising the Council to transfer its undertaking to the Electrical Distribution of Yorkshire, Ltd., and for an extension of time of the Council's Electric Lighting Order of 1912, for the laying of mains, &c.

Japan.—Growth of Electrical Industry.—The *Electrical World* states that official figures issued by the Department of Communications of Japan put the number of supply stations in the island at 715, the electric railways at 42, and the companies operating both central stations and railways at 53, making a total of 810 electrical enterprises, or an increase of 57 over last year. The total capital of central stations is put at 763,000,000 yen, of electric railways at 56,000,000 yen, and of central stations and railways which are combined at 453 000,000 yen—a total of 1,272,000,000 yen, indicating an increase over last year of 177,000,000 yen.

Liverpool.—Loan Sanctioned.—The Corporation has received the formal sanction of the Electricity Commissioners to the borrowing of £50,000 for prospective expenditure on electric mains.

London.—Camberwell.—The Borough Council, which asked its local members of Parliament to oppose the County of London Electric Supply Co.'s Bill, has had the following letter from Lieut.-Colonel Sir Frederick Hall :—

"I really fail to understand the opposition of your Borough Council to the proposed measure, as I should have thought that Camberwell had everthing to gain and nothing to lose by these proposals. Surely the cheaper a company is able to generate current, the better its position for supplying its consumers with electricity at a cheaper rate.

"You will recognise that it is not proposed to build a generating station in Camberwell, but that the borough is to be supplied with distribution mains. If there had been a suggestion to erect a generating station in Camberwell I could, to a great extent, understand the opposition, as it might be justified, because your Council could argue that when the time comes for purchase they want to be in a position to buy a complete undertaking—that is to say, generation as well as distribution; but the County of London Electric Co. have no generating station in the district, and have no intention of building one, as I think I am right in saying they are supplied at the present time from Wandsworth.

"You will, of course, realise that under the circumstances I cannot support the resolution contained in yours under answer."

Hackney.—The *Poor Law Officers' Journal* says the Hackney Guardians propose to replace gas with electricity at their Homerton Institutions, and have decided to generate electricity themselves, instead of asking for a municipal supply. The schemes are estimated to effect an annual saving, based on the present prices of fuel, gas and electricity, of approximately £8,000—with the capital expenditure entirely written off. In addition to the installation of electric lighting plant—which has not yet been put into commission, and the anticipated saving on which has not been included in the calculations already made—the schemes comprise the utilisation of the exhaust steam in conjunction with the centralisation of the domestic hot-water supply; the burning of coke-breeze in lieu of steam coal; and the centralisation of the heating systems. Since they were first inaugurated the total expenditure has been £14,693, while the results have been so economical that the whole of this outlay has already been more than recouped, and, as stated, the Guardians are now promised a saving of £8,000 a year.

The Electricity Committee reports that it has secured an e.h.p. feeder and switchgear, from the National Projectile Factory at Hackney Marshes, at a cost of £2,379. The Committee has saved a great deal of expenditure in this manner; it previously secured an e.h.p. cable and switchgear from the factory for £2,516.

Fulham.—The Electricity Committee recommends the provision of two additional 200-kVA transformers, and the necessary switchgear at Messrs. Van den Bergh's sub-station. The estimated cost is £1,100.

The Council has secured the approval of the Electricity Commissioners to improvements at the electricity works. These include the replacement of economisers, alterations to the transformer house, fixing a new centrifugal pump and accessories at an estimated cost of £21,000.

Islington.—In order to meet an anticipated deficit on the electricity undertaking, the Finance Committee recommends that the charges for electricity be increased as from the March meter readings as follows:—For units sold at basic rates of 1½d. and upwards from 70 to 100 per cent. on the basic rates; for units sold at 1d. and under, from 120 to 150 per cent. on the basic rates.

Manchester.—House Lighting.—At a recent meeting of the City Council, it was proposed that the houses on the Anson estate should be illuminated by gas, and those on other estates by electricity. An amendment was carried that electricity be adopted throughout.

Mohill (Co. Leitrim).—Power Station Destroyed.—The power house has been destroyed by fire. The occurrence is stated to have been due to an accident.

Musselburgh.—Supply Rights Question.—It was reported at a special meeting of the Town Council that a firm of manufacturers in Musselburgh had refused to take a supply of electricity from the Musselburgh Electric Light and Traction Co., and had asked for a supply from the Edinburgh Corporation. The latter authority was willing to give a supply if the consent of the local authority could be obtained. The Electric Light Co. objected to this arrangement, as it would infringe rights which it had obtained at great expense. The question was referred to the Law Committee to ascertain in what position the Town Council would place itself by withholding or giving consent.

Navan.—Electric Lighting Scheme Postponed.—The Munster and Leinster Bank intimated to the Urban Council that the directors could not see their way to grant a loan of £10,000, repayable in 20 years, for a public electric lighting scheme. It was therefore agreed to postpone the scheme for 12 months.

Perth.—Company's Scheme Approved.—Subject to protective clauses being inserted, the County Council has consented to an electric lighting order being applied for by the promoters of the Dunblane electricity supply scheme.

Stockton-on-Tees.—Allocation of Profits.—In his review at the Corporation's annual finance meeting Ald. F. T. Nattrass stated that the electricity undertaking did not affect the rate levy on that occasion, but the Committee anticipated being able at the end of the new year to transfer a surplus of £1,204 to the reserve fund, from which the Committee contemplated providing for the cost of the reconstruction of switchboards and the extensive renewal of feeder cables.

South Shields.—House Lighting.—At a meeting of the Electricity Committee, the electrical engineer stated that he had reported to the Housing Committee the negotiations that had been proceeding between himself and the County of Durham Electrical Power Distribution Co. with regard to the terms on which the company was prepared to supply electricity in bulk within the area covered by the proposed extension of the borough. The Housing Committee had instructed him to endeavour to secure further concessions from the company, and the matter was having attention.

Extensions.—The engineer also introduced the question of extending the boiler house at the generating station with a view to making provision to accommodate at an early date, two new water-tube boilers, complete with economisers, induced draught fans, chimney stack, and all necessary auxiliaries. The demand for electricity is constantly increasing for lighting, heating and power, and this, together with the further demands of the tramway department for the proposed light railway, requires that preparations be made for extra steam-raising plant at an early date so as to provide for the department's requirements in this direction for the winter of 1922. The borough engineer was instructed to prepare plans, specifications, quantities, and estimates for the building.

Swansea.—Oil Fuel Proposed.—The Electricity Committee received a report from the electrical engineer stating that, in consequence of the shortage of storage accommodation for coal, the Committee should take into consideration the question of providing an alternative method of firing the boilers by means of liquid fuel. With a few modifications the change could be made, and at the shortest notice coal firing could be resumed. He did not say that oil was cheaper than coal, but in times like the present coal crisis, it was necessary to have liquid fuel as a stand-by. The Committee referred the matter to the Standing Sub-Committee for consideration.

Teignmouth.—Electricity Supply.—The Urban District Council has resolved that Messrs. J. & W. Purves be informed that it would welcome the introduction of an electricity supply to Teignmouth, but that it has no wish to take over the Teignmouth Electric Light Order held by the firm.

Wallasey.—Report on Breakdowns.—The Special Joint Committee of the Corporation appointed to inquire into the causes of the breakdowns at the power station has issued its report, which makes the following recommendations :—(1) Immediate steps should be taken to reorganise the staff of the generating station; (2) the engineer's office should be removed to, and adjoin, the Poulton power station, and that office accommodation should be provided for the station superintendent; (3) that the electrical engineer should reside in the borough as near to the station as possible; (4) that an expert should be called in to investigate the primary cause of the corrosion of the pumps, and that periodical chemical tests should be made of the boiler contents; (5) that the turbines should be so controlled as to ensure steam being cut off when sets are standing; (6) that the boiler feed pumps should be periodically

tested and opened out for inspection; (7) that the pumps should be so fixed that they can be easily examined, dismantled, and in a position that is reasonably clean, and that an additional feed pump be installed.

West Hartlepool. — Station Closed Down. — The electrical engineer reported, last week, that in consequence of the industrial situation the Seaton Carew Iron Co. was closing down its blast furnaces, so that no waste heat would be available for the Corporation's generating station. It was decided to close down the generating station for the present, and take a bulk supply from the Cleveland and Durham County Electric Power Co.—*Yorkshire Post.*

Worcester.—Future Extensions. — The Electricity Committee has issued a report in which it points to the probable increase in the demand for electricity during the next three years. It will be necessary to carry out considerable extensions, and the cost of these is estimated at £62 200. The Committee desires authority to ask for loans to carry out the work, and in the event of its failing to secure sanction to borrow the amount it proposes to ask the Electricity Commissioners for an order making a sub-district of South Worcestershire to be administered by a committee on which Worcester should be represented.

TRAMWAY AND RAILWAY NOTES.

Accrington.—No Restoration of Penny Fares.—An effort to refer back a recommendation in opposition to the restoration of penny fares was defeated at a meeting of the Council. Ald. Higham, chairman of the Tramways Committee, said such a policy, however much stages were shortened, would bring the tramway undertaking on the rates. Nothing had been put to reserve for the renewal of the track during the past six years.

Australia.—Brisbane.—Up to a month or two ago, negotiations had been proceeding for the acquisition by the Queensland Government of the Brisbane tramways at the expiration of the holder company's "franchise." The company stated a price in the neighbourhood of £3,000,000, but having regard to the great expenditure which would have to be incurred after purchase, the Government is not inclined to take any further steps in the matter at present.

Melbourne.—From March 7th the fares on the Metropolitan Tramway systems were increased. The 1d. fare was raised to 1½d. on weekdays and 2d. on Sundays and holidays. The new rates are expected to give an increase in revenue of £160,000 up to the end of the year, or £195,000 for the complete financial year.

Barrow. — Cancellation of Deficit. — The Finance Committee has decided to grant the Tramways Committee the sum of £14,000 to enable an accumulated deficit of £15,680 on the undertaking to be wiped out. The balance of the deficit is to be carried forward to the next period, when it is hoped that decreased expenditure will make it possible to cover the amount.

Bradford.—Deficit.—For the first time for many years, and in spite of record receipts, the tramway undertaking incurred a loss of about £80,000 during the year just ended. The chairman of the Tramways Committee attributed this deficit chiefly to the high expenditure upon renewals, which represented 3d. per car-mile.

One-man Cars, &c. — Having recently received from the Ministry of Transport a statement that no objection is raised to the use of a new single-deck type of railless car, with only one man in charge, the Bradford Tramways Committee has instructed the general manager to prepare an estimate of the cost of these cars, and to obtain information as to the working expenses of petrol-motor omnibuses operated in other towns.

The Committee, at its April meeting, resolved to recommend to the Parliamentary Sub-Committee of the Corporation that in the next Bill promoted in Parliament by the Corporation, power be sought for the construction and operation of double-deck, top-covered railless trolley vehicles of a four-wheeled typed, weighing not less than 7½ tons, and of a six-wheeled type weighing not less than 9½ tons, unladen weight in both cases.

Darlington.—Effect of Fare Increase.—It was stated at a recent meeting of the Council, that since increased fares had been put into force, the revenue had increased by 4 per cent., while the number of passengers carried was reduced by 7½ per cent.

Dewsbury.—Extensions Deferred. — At a Town Council meeting, last week, it was reported that the Electricity Committee had considered a proposed extension of the town tramway termini in the Market Place, so as to avoid congestion, but found this would cost over £4,000, and under the present conditions it had decided against the expenditure. It had also, for the same reason, dropped a proposed scheme of running cars by Longcauseway, which would cost between £7,000 and £8,000. A proposition that the matter should be referred to the General Purposes Committee was defeated, and the minutes were adopted.

Edinburgh.—Car Conversion.—Under the supervision of the tramway manager (Mr. Pilcher), one of the old cable cars has been converted at the Shrubhill works for use as an electrically-driven vehicle at a cost of about £300. This is a great saving to the Corporation, as a new car is estimated to cost £2,000 at the present time.

Essex.—Light Railway Loans.—The Ministry of Transport recently informed the Parliamentary Committee of the Essex County Council that, owing to a decision of the Cabinet, the Ministry was unable to sanction any grants or loans for the construction of light railways for a period of 12 months.

Liverpool.—Effect of Fare Increase.—Liverpool Corporation tramway traffic returns show that during the first three weeks of the increased fares, there was a decrease of no less than 2,374,304 passengers, yet there is a daily increase in revenue of between £500 and £600. The present increase in the receipts, however, is only about one half of what is required to meet the year's expenditure.

Newcastle-on-Tyne. — Prospective Expenditure.—The estimated expenditure by the Tramways Committee during the current year includes the following items:—Alterations and new pumps and pipes in pumping station, £4,000; renewals to cars, £12,500; purchase and equipment of motor-buses, £2,000; reconstruction of overhead work, £4,000; new plant in power station, £35,000; renewals to permanent-way, junctions, &c., £46,360; total, £103,860.

New Routes Opened.—On April 8th the new tramway routes to West Moor and Forest Hall were formally opened. This completes a programme of construction commenced by the Corporation in 1914. The system now extends from one side of Gosforth Park by a wide circular route to the other side, and it is hoped that the circuit will be completed through the Park under a foreshadowed scheme of construction.

Uruguay.—Tramways *v.* 'Buses.—The High Court of Justice has recently given an important decision affecting tramway companies' rights. The tramway companies of Monte Video brought an action some time ago against the Government for infringement of their rights by instituting a motor-'bus service over routes served by them. The Court of First Instance decided in favour of the Government. The companies appealed, and the Court of Second Instance decided in their favour. The High Court has now reversed this decision, giving judgment in favour of the Government.—*Review of the River Plate.*

United States.—New York Improvements.—In the recently-published report of the New York-New Jersey Port and Harbour Development Commission, a number of proposals are made for the re-organisation of services at the two ports.

At the present time there are 12 railways with termini at the port of New York, each of which has its own clearing arrangements; there is practically no means by which trains from one system can be transferred readily to another system. It is proposed, therefore, to construct "belt lines" in the vicinity of the Port; over these lines freight cars, connected with all the existing lines, will run. A series of multiple-story clearing houses or "freight terminals" will be erected, and beneath these will be tunnels in which will operate small electric trailer trucks. These trucks will take over goods from trains at a transfer yard. At the freight terminals lifts will be provided capable of taking one of the trailer trucks at a time, and raising it to the correct floor of the building.

Wednesbury.—Track Renewals.—The South Staffordshire Tramways Co., Ltd., has intimated to the Wednesbury Town Council that it intends to relay the track along the Darlaston Road to the Bull Stake.

TELEGRAPH AND TELEPHONE NOTES.

Cable and Wireless Rates.—"Deferred Rate" Services Re-opened.—Marconi's Wireless Telegraph Co., Ltd., has re-started its deferred (L.C.O.) service to Canada, Newfoundland, and the West Indies, which has been suspended since 1917. The cost of transmission by this route is less than that for a corresponding service by the cable companies. On April 9th the Western Union Telegraph Co. re-introduced its deferred service between the United Kingdom and the United States of America and Canada, which has been suspended since September, 1918.

Cable Delays.—It will be remembered that during the sittings at Washington of the International Conference on Communications, last autumn, statements were made to the effect that commercial telegrams passing between the U.S.A. and the Continent had been intercepted by the British authorities, and the impression was created that they were purposely delayed, or improper use had been made of the information they contained. The correspondence which passed between the British Ambassador at Washington and the U.S. Secretary of State, together with a note by Lord Curzon on the subject, has been published as a White Paper (Cmd. 1,230).

Cuba.—New Cable.—Mr. C. H. Mackay, president of the Commercial Cables Postal Telegraph System, announced recently the inauguration of a new cable between Miami (Florida) and Havana (Cuba), and also of several new telegraph offices, which

are calculated to provide increased reliability and improved service with Cuba, and a competitive telegraph service on the east coast of Florida.

Long-distance Telephony. — *The Times* correspondent at Washington states that on April 11th he took part in a long-distance telephone conversation from the Pan-American Union building to Havana, and with a wireless operator in Catalina, an island in the Pacific off Los Angeles. He proceeds: "As plainly as though we were all seated in the same room, I heard Havana speaking to Catalina and Catalina answering. It was by far the longest conversation in point of distance ever held by telephone. The message to which I listened passed through 115 miles of cable, connecting Havana and Key West, in Florida, thence over the land wires connecting the chief towns of the Atlantic seaboard with New York, Chicago, Omaha, Salt Lake City, Sacramento, San Francisco, Fresno, and Los Angeles, and from Los Angeles by wireless to Catalina, 29 miles from the mainland, a total distance of 5,056 miles. In quick succession the transcontinental roll call was taken, and we heard voices responding from 26 towns situated in 19 different States. Col. John J. Carty, the vice-president and chief engineer of the American Telephone and Telegraph Co., to whose organising ability the demonstration owes its success, afterwards observed: Had to-day's conversation been held over land wires only, it could have been heard exactly with the same clearness over 10,000 miles of land wires, weighing 435 lb. per mile, and equipped with telephone repeaters and other apparatus of various kinds used in America."

Stock Exchange and Wireless.—The Stock Exchange demands upon the London-Paris wireless service are such that special relays of Marconi messengers have been made available, from April 11th onwards, at 75, Old Broad Street, Shorters Court (American door), and New Court door. By the attendance of these messengers between the hours of 10.30 a.m. and 3 p.m. it is hoped to save members the necessity for telephoning the Fenchurch Street office.

Empire Wireless Chain.—It will be remembered that the Imperial Wireless Telegraph Committee, 1919-20, of which Sir Henry Norman, M.P., was chairman, and which reported last June, recommended, among other things, that a scheme of Imperial wireless communications should be established connecting the communities of the Empire by geographical steps of about 2,000 miles each; and that these stations should be planned by a Wireless Commission of about four members. A Commission was accordingly appointed. It consisted of Lord Milner (chairman), Dr. Eccles (vice-chairman), Mr. L. B. Turner, Mr. Shaughnessy, and Lieut.-Col. Crawley (secretary), who was assistant secretary to Sir H. Norman's Committee, of which Dr. Eccles and Mr. Turner were members. With the exception of Lord Milner, the members of this Commission are now engaged, says *The Times*, in investigating the latest developments of wireless telegraphy. They will report this summer, but no decision with regard to Empire wireless will be taken until after the Imperial Conference which is to be held in London in June.

France.—Wireless Communication.—An objection has been raised by M. Poulle, a member of the Senate, against the Convention of October 29th, 1920, handing over the French wireless plant and communication systems with Great Britain, Spain, and the United States to a private company. It is declared that such a convention is null and void by law, as the Posts and Telegraphs are a State monopoly. M. Poulle has tabled a resolution inviting the Government to submit the Convention to Parliament for its approval, and M. Laffont, Under-Secretary for Posts and Telegraphs, has agreed to this course.

M. Laffont, on April 9th, explained that the contract did not confer a monopoly on the company. Furthermore, the employés and the members of the Board of Administration must be Frenchmen, and the working, as well as the tariffs, must be under the control of the Administration; the work of construction must be carried out at the company's expense, and all working expenses be borne by the company. Consequently, continued the Minister, there was no risk to the State which had benefited from the company's receipts. The Minister's explanations satisfied the Senate and the resolution of M. Poulle was referred to the Senate Financial Committee.—*Reuter's Trade Service* (Paris).

Greenland.—Wireless Station. — According to the Copenhagen *Sociald Demokraten*, the building of a wireless telegraph station is again under consideration, and the British authorities are said to have approached the Danish Government in connection with the matter.—*The Times.*

Telephone Service.—Cancelled Contracts.—Mr. Pike Pease, replying to a question in the House of Commons, said that about 10,000 subscribers had cancelled their telephone contracts during February and March. As, however, that number was about the average, it was impossible to say how many cancellations were due to the increased rates.

Parliamentary Committee's Inquiry. — The recently appointed Parliamentary Committee charged with inquiring into and reporting upon the working of the telephone service, met for the first time for the taking of evidence on April 6th at the House of Commons. The first witness was Sir Evelyn Murray, Assistant Secretary to the Post Office. There was a full attendance of the 15 members of the Committee, over which Mr. E. Cecil presided, and Mr. William W. Cook (a consulting engineer who was connected with the old National Telephone Co.) was appointed the Committee's scientific assessor.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—April 27th. Victorian Railway Commissioners, Spencer Street. Caustic soda primary cells, complete (Contract No. 33,914).*

Postmaster-General's Department (Melbourne). May 31st. Telephone switchboards (Schedule No 1,670).*

Postmaster-General's Department, May 31st. Supply and delivery to several States manual telegraph transmitting devices (Schedule No. 1,680). (April 8th.)

May 2nd. With reference to the recent invitations to tender by the Victorian Government Railways for 12 miles of two-core, lead-sheathed, wire-armoured 2,200-volt cable, the Department of Overseas Trade learns from H.M. Senior Trade Commissioner in Australia that the Railway Department is prepared to give consideration to alternative offers for cable with the section of each core 0145 sq. in., in lieu of 015 as originally specified.

May 31st. Victorian Electricity Commissioners. Morwell power scheme: Street poles (Specification No. 47); copper cable (Specification No. 66). (See this issue.)

Victorian Railway Commissioners. June 22nd. One electric lifting magnet (capacity ½ ton), one 440-V motor generator.

June 29th. Supply of 1-ton platform type industrial storage battery trucks, also battery charging equipment.—*Reuter's Trade Service* (Melbourne).

Ballinrobe. — April 23rd. Electricity Supply Co. Wiring of consumers' premises. (April 8th.)

Belgium. — May 27th. The Service d'Etudes et de Controle des Applications de l'Electricité, 52, Boulevard du Regent, Brussels. For the supply and installation of ten electrically operated capstans in connection with the locks on the Upper Scheldt.

Buenos Aires.—June 3rd. The Commercial Secretary to H.M. Legation at Buenos Aires (Mr. H. O. Chalkley) reports that the Board of Sanitary Works of the Nation at Buenos Aires is again inviting tenders, to be presented by 3rd June, for the supply and erection of the plant and accessories for a new generating station, previous tenders having been called for in 1919 and 1920. The plant comprises three four-cycle Diesel engines of 375-h.p., and adapted to run on crude petroleum from Comodoro Rivadavia, and three three-phase alternators, each of 250-kW, 2,200 volts between phases, 50 cycles and power factor of 8. A copy (in Spanish) of the general conditions of tender and specification, also a blue print showing the general layout of the plant, can be seen at the Department of Overseas Trade in London, on application to Mr. Holloway (Victoria 9040: Extension 4) until April 23rd.

Dewsbury.—April 23rd. Electric-light installation at Eastborough Working Men's Club, Battye Street. Specifications, &c., the Secretary.

Fiji Islands.—The municipality of Suva invites tenders, closing June 30th, for the supply and erection of a 200-kW, 480/520-V, three-wire, d.c. generator, directly coupled to a 300-h.p. vertical Diesel oil engine, together with accessories for generator and panel.—*Reuter's Trade Service* (Melbourne).

Ipswich.—Electricity Supply Department. One 500-kW rotary converter or motor converter. (See this issue.)

Jugo-Slavia.—May 1st. The Serb, Croat, and Slovene Ministry of Public Works. Erection of a power-station, main conductors and transforming stations in connection with an electrical scheme at Kostolac for the supply of energy to Belgrade, Semlin, &c.*

Keighley.—April 23rd. Tramways Department. One 2 to 3-ton petrol chassis, one 2 to 3-ton petrol end-tip wagon. (See this issue.)

London.—L.C.C. April 18th. 5,500 tons of standard steel girder tramway track rails, lipless track rails and renewable guard rails with fastenings. Chief Engineer, County Hall, Spring Gardens, S.W. 1.

Lowestoft.—April 18th. Electricity Department. L.p. cable feeder pillars, joint boxes, &c. (April 8th.)

Manchester.—May 2nd. Electricity Committee. Three steam turbine-driven boiler feed pumps. (See this issue.)

New Zealand.—April 19th. Public Works Department. H.M. Trade Commissioner has forwarded particulars of a call for tenders for 6,000 pin insulators, suitable for a line operating at 66,000 volts between phases. Tenders (accompanied by deposit of £100) to the Secretary, Public Works Tenders Board, Government Buildings, Wellington. Specifications may be seen at the Department of Overseas Trade, 35, Old Queen Street (Room 59), Westminster, S.W.1.

South Africa.—Pretoria.—May 10th. Municipality. Switchgear. Tenders, marked "Electric Light and Power Department, 1920 Extensions, Contract No. 5," to Deputy Town Clerk, Municipal Offices, Pretoria. Deposit, five guineas. Further particulars may be obtained from the general manager of the Electric Light and Power Department, or from the consulting engineer, Mr. G. M. Clark, 40-42, Maschkal's Buildings, Johannesburg.

Johannesburg. — June 22nd. South African Railways and Harbours. Electrification of Capetown-Simonstown and Durban-Maritzburg lines: Overhead equipment of permanent way and overhead transmission line, switchgear and accessories, and trackbonds. (April 1st.)

Spain.—Madrid.—April 30th. La Sociedad de Ferro-carriles Electricos, Plaza de Canovas 4, Madrid. 2,750 metric tons of rails, fish plates, nuts, bolts, points, &c., for the Calaherra-Arnedillo Electric Railway.

St. Anne's-on-Sea. — Electricity Department. One natural draught cooling tower. (See this issue.)

St. Helens.—May 1st. Electricity Department. One d.c., 3-wire, distributing switchboard, complete with supporting steel-work. (April 8th.)

* A copy of the specification, &c., can be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W.1.

CLOSED.

Belgium.—Five tenders were received by the Société Nationale des Chemins de Fer Vicinaux, of Brussels, last week, for the supply and laying of the underground armoured cables required in connection with the distribution of the current for the lines in the Louvain district, the lowest offer (175,665 francs) being that of the Société Omnium Electrique, of Dison, Belgium.

The Belgian Post and Telegraph authorities in Brussels last week placed some large contracts for miscellaneous telephone material, the principal orders being divided between the New Antwerp Telephone and Electrical works, of Borchem, Antwerp, and the Bell Telephone Manufacturing Co., of Antwerp.

Bolton.—Tramways Committee. Accepted:—

400 tons of tram rails and 10 tons of fish plates.—W. Scott, Ltd.

Bradford.—Electricity Committee:—

Ash-handling plant for No. 4 boiler-house at Valley Road Works, £7,924.—Underfeed Stoker Co., Ltd. (London).

Steelwork for foundations of new cooling towers at Valley Road, £390.—H. Barrett & Sons Ltd.

Steel casing cover for vertical turbo-generators at Valley Road, £735.—British Thomson-Houston Co., Ltd.

Canterbury.—Town Council:—

Steam pipe work, Electricity Works, £917.—John Spencer, Ltd.

Standard steel cubicles, for switchgear, £100.—Ferguson, Pailin, Ltd.

Steel framework supports for oil tank, £53.—Superheater Units, Ltd.

Cork.—Electric motors for lighting, refrigerating plant, &c., for the Irish Creameries and Exporters' Association, Ltd., Cork. —The Electric Tramways & Lighting Co., Ltd.

Doncaster.—Electricity Committee:—

Construction of foundations for installation of new plant at Electricity Works, £1,139.—C. Sprakes & Sons.

Folkestone.—Town Council:—

E.l. installation, Enteric block, Sanatorium. £33, plus £30 for extension of main cable.—Marchant & Co., Folkestone.

Electric lighting, zigzag path (lights for three standands, lamp tops, five other lights, wires and cables, £163.—Folkestone Electricity Supply Co., Ltd.

Nigeria.—The civil engineering and contracting department of Sir. W. G. Armstrong, Whitworth & Co., has obtained, in competition, the contract, from the Crown Agents for the Colonies, for the Ebute Metta workshops, which are to be erected near Lagos for the Nigerian Government Railways. The contract consists of the supply, erection and equipment of new locomotive shops, carriage and wagon shops, an electrical power-station, saw-mills, &c. The contract time for completion (says the *Financial Times*) is two years.

South Africa.—Mossel Bay, Cape Province.—The tender of Messrs. Higham & Co., of Mossel Bay, has been accepted by the municipality for the house-wiring of all buildings to be connected to the new municipal supply, at £2 7s. 6d per point for enamelled close-joint conduit laid on the surface, with additional prices for concealed work, &c.

Beaufort West, Cape Province.—The tender of Messrs. R. G. Jack & Son, of Cape Town, has been accepted for the municipal house wiring.

Swansea.—The Corporation Electricity Committee last week accepted the tender of the Switchgear Construction Co. for switchgear for the station, price £959. The engineer (Mr. Burr) reported that two tenders had been received for meters, one from a British firm that had bought German meters, which were offered at £2 2s. each, and the other from a British firm offering British meters at £2 18s. The quality was about the same, and he wanted the instructions of the Committee, as the German meters meant a considerable saving, seeing that he required 600 meters. During discussion it was stated that probably these meters were bought before the reparation proposals were made, under which the Government intends to hold 50 per cent. of the cost of German exports by way of payment of the German indemnity; but the chairman, Mr. Alex. Sinclair, said that doubtless in any future exports the Germans would put the 50 per cent. on the price. Councillor Daniel Jones moved that the Committee accept the British meters. Was it worth while considering, seeing that so many British works were at a standstill? "Be hanged to the Germans and their goods," he added. Eventually, however, the matter was deferred pending further inquiries as to the effect of the reparation proposals.

Wakefield.—Electricity Committee. Accepted:—

Constructional work, foundations, pipe lines, &c., the basis of payment to be 10 per cent. on materials used and 33 per cent. on wages paid.—Parker & Sharp.

Wolverhampton. — Corporation Electricity Committee. Accepted:—

British Insulated and Helsby Cables, Ltd., £42,297, for the supply, laying and jointing of a 33,000-volt trunk main and pilot cable between Wolverhampton and Cannock.

British Electric Transformer Co., Ltd.—Four 2,000-kVA, 33,000 and 6,000-V single-phase transformers, £9,924.

Metropolitan-Vickers Electrical Co., Ltd.—Switchgear units, including protective gear for Hilton sub-station, £4,445, plus 10 per cent. for contingencies; battery and motor generator, £250.

General Electric Co., Ltd.—Switch and metering gear for Cannock sub-station, £1,350, plus 10 per cent. for contingencies; battery and motor generator, £250.

Reyrolle & Co., Ltd.—3,000-V, three-phase oil switch and panel as an extension to the existing switchboard, including special relay, for Commercial Road generating station, £1,373, plus 10 per cent. for contingencies.

Ferguson, Pailin, Ltd.—Eight sets of e.h.p. switch cubicles, £104 each set.

£250 is to be paid by the Metropolitan-Vickers Electrical Co., Ltd., as an extra to their contract for the supply of one 250-kW rotary converter.

Worthing.—Electricity Committee. Accepted:—

Feeder cables, £2,231.—Callender's Cable and Construction Co., Ltd.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 15th. At Caxton Hall, Westminster, S.W. At 8 p.m. Paper on "The Metering of Steam," by Mr. C. R. Sams.

Electrical Power Engineers' Association.—Lectures on "The Work, Aims and Scope of the Electrical Power Engineers' Association," will be given on Saturday, April 16th, at the Y.M.C.A., Leeds, at 6.30 p.m.; Wednesday, April 20th at the Connaught Hall, Newcastle-on-Tyne, at 7 p.m.; and on Saturday, April 23rd, at the Royal Victoria Hotel, Sheffield, at 7 p.m.

North of England Institute of Mining and Mechanical Engineers.—Saturday, April 16th. At the Wood Memorial Hall, Newcastle-on-Tyne. At 2 p.m. General meeting.

Royal Society of Arts.—Monday, April 18th. At John Street, Adelphi, W.C. At 8 p.m. Cantor lecture, "Recent Applications of the Spectroscope and the Spectro-photometer to Science and Industry," by Mr. S. J. Lewis.

Institution of Electrical Engineers.—

North-Western Centre.—Tuesday, April 19th. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. smoking concert.

South-Midland Centre (Students' Section)—Tuesday, April 19th. At the University, Birmingham. At 7.30 p.m. Address by Mr. F. Forrest. Annual general meeting.

Institution of Civil Engineers (Students' Section).—Wednesday, April 20th. Visit to the electric generating station (L. & N.W. Rly.), Stonebridge Park.

Chemical Society.—Thursday, April 21st. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Manchester Wireless Society.—Thursday, April 21st. At the Albion Hotel. At 7.30 p.m. Ordinary meeting.

Roentgen Society.—Thursday, April 21st. At the University College, Gower Street, W.C. At 8.15 p.m. General meeting.

Edinburgh Electrical Society.—Friday, April 22nd. At the Philosophical Institute. At 8 p.m. Open night.

Physical Society of London.—Friday, April 22nd. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

Royal Institution of Great Britain.—Friday, April 22nd. At Albemarle Street, W. At 9 p.m. Lecture on "Electro-Synthesis in Organic Chemistry," by Sir James Walker, F.R.S.

Technical Inspection Association.—Friday, April 22nd. At the Royal Society of Arts, John Street, Adelphi, W.C. At 7.30 p.m. Lecture on "The Physical Properties of Clay," by Mr. A. S. E. Ackerman.

NOTES.

The late Mr. T. E. Gatehouse.—We regret that in our last issue the birthplace of Mr. Gatehouse was incorrectly given as Eye, in Suffolk; his early boyhood was spent at Eye, but he was born at Norwich, in Norfolkshire.

The Prince of Wales's Calendar.—The Prince of Wales has given permission for the National Portrait Fund to publish "The Prince of Wales Calendar for 1922," in aid of all those men of the three Fighting Services, irrespective of rank, who defended their Empire with self sacrificing loyalty and devotion, and now find themselves in want. The Calendar is of beautiful design, and mounted upon it is a specially-selected unpublished portrait of the Prince reproduced in English photogravure. In commending this Calendar and its object to our readers we strongly suggest that before ordering their usual supplies for 1922, all firms should make a point of communicating with the Hon. Secretary, The National Portrait Fund, 13, Duke Street, St. James's London, S.W.1 who will willingly send samples and full particulars. It is hoped that every commercial house will follow the Prince's lead in this great cause by giving its practical support.

Street Accidents.—An official return of street accidents in the United Kingdom during 1920 records a serious increase over the 1919 figures. Fatal accidents numbered 2,837, as against 2,628 in the previous year, while non-fatal accidents rose from 48,698 to 54,910; these figures show a percentage increase of 12·5. An analysis of causes attributes 2,527 accidents to tramway cars, horse-drawn vehicles were responsible for 2,836, omnibuses for 1,756, and "other mechanical vehicles" for 10,636 accidents. To this last class 443 deaths are attributed, tramway cars caused 41 deaths, omnibuses 82, and horse-drawn vehicles 73. The greatest number of accidents in any one town occurred in Liverpool (2,145). In Glossop only one (non-fatal) accident occurred.

A Wirelessly-Controlled Clock.—Mr. T. S. Casner, a mechanical engineer, has perfected a clock that is entirely automatic in its operations, and is corrected daily by the wireless impulse sent from Washington for that purpose. It is self-winding, and besides indicating time itself, the clock will operate and control any number of secondary clocks. The apparatus is so designed that it selects the one signal flashed at the exact hour of 12 noon, and makes possible, it is believed, for the first time the synchronising of time-pieces all over the country by wireless.—*Reuter's Trade Service* (New York).

Freemasonry.—At the regular meeting of the Kelvin Lodge which was held at the Connaught Rooms on Thursday, 31st ult., the reigning Master, Mr. H. Porter-Cox, presided over an assembly of 87 members and visitors, including many men well known in the electrical profession, and during the speeches at the Banquet following the Masonic Ceremonies, he referred to the fact that he would shortly be installed in the Chair of the Kelvin Chapter, and would then be occupying simultaneously the Chairs in both the Lodge and Chapter. He expressed his keen appreciation of the way in which he had been supported by the members in connection with the Great Masonic Charities, and referred to the rapid growth of the Lodge during the last few years, which showed the interest taken in the Craft by the electrical engineering profession, and the desire of so many of those who were associated therewith to become members of the Lodge.

Service Notes.—The following revision of the substantive scales of pay of certain grades of the electrical generating, &c., staffs employed at H.M. Dockyards and Naval Establishments at home, is approved. Weekly rate for hired men:—Mains and distribution supervisor, 51s. to 60s. (for a working week of 47 hours); "A" class station supervisor, 59s. 6d. to 73s. 6d., for a working week of 55 hours, working in shifts. These rates are subject to the regulation deduction in the case of established men. For "B" class station supervisors and drivers, and dynamo attendants, the revised rate is 47s. 10d. Warrant Electrician W. A. Nimmy has been appointed to the battleship *Ramillies* from the 9th inst., and Warrant Electrician Ford to the battleship *Agamemnon* from the same date.

Withdrawal of Electric Coal-Cutters Recommended.—The Committee appointed to inquire into the question of the safe working or otherwise of the electrically-driven coal-cutting machines at Mount Kemble Colliery, recommends the withdrawal of these machines until such time as safe conditions can effectively be established, as in the Committee's opinion it is not safe to work them in the Mount Kemble Colliery at present. A copy of the Committee's report may be consulted by United Kingdom firms interested on application at the Inquiry Room, Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W. 1.

Appointments Vacant.—Assistant Professor of Electrical Engineering, having special knowledge of telegraphy and telephony, for the City and Guilds (Engineering) College (£600 to £800); works manager, for the Stockton-on-Tees Corporation Electricity Department: ledger clerk, in the Hackney Borough Treasurer and Accountant's Department (Electricity Section), £310; shift engineer, for the Redditch Urban District Council Electricity Department; general manager, for the Wigan Corporation Tramways (£700); assistant electrical engineer (632 Rs. 8 annas per month), for the Great Indian Peninsular Railway. See our advertisement pages to-day.

No Summer Time in Canada.—In the Dominion House of Commons on April 11th, it was stated that the Government would not introduce legislation to establish "daylight saving" time. In the absence of a Federal enactment last year some municipalities adopted daylight saving, but others did not, with the result that much public inconvenience was caused.—*Birmingham Post.*

Charging for Idle Current.—An error occurred in the article by Mr. C. G. Carrothers in our issue of April 1st, in the value of p; on p. 405, lines 13 and 16, and in the key to the figure, for 1·5 read 1·25.

The Defence Force.—Men with special technical knowledge are urgently needed, such as field or P.O. linesmen, motor-cyclists, instrument repairers, operators (line, visual and wireless), and telephone switchboard operators. Depôts are at 3, Henry Street, Gray's Inn Road, for 1st London Division (D.F.) Signal Company; 46, Regency Street, S.W.1, for London Electrical Engineers (D.F.); and Elverton Street, S.W.1, for 3rd (London) Corps Signal Companies (D.F.). Electrical and mechanical engineers are needed to complete the requirements of the Force.

Deterioration in Slack.—A letter has been received by the F.B.I. from a member firm drawing attention to the deterioration in the quality of slack during recent years, and was read before a meeting of the Coal Committee at the head office on March 17th. As the subject is one of great importance to fuel-consuming interests throughout the country, it was felt that the subject should be brought up for full consideration at the next meeting of the Committee. The member firm suggests that the deterioration in slack is due to three main factors:—(*a*) The use of shaking screens with a fine mesh instead of the older fashioned fixed bar screen; (*b*) The use of high explosives in the pits; and (*c*) The practice of loading by shovel instead of by rake and basket. The F.B.I. will be pleased to learn the experience of those members who are slack users in dealing with this difficulty, and to receive their suggestions concerning possible remedies.

The Electricity Supply Bill.—On Tuesday, Sir E. Geddes, Minister of Transport, presented a Bill in the House of Commons to amend the Electricity (Supply) Act, 1919.

The Threatened Strike.—On Tuesday, the Executive of the Electrical Trades Union, at a meeting in London, decided to support the railwaymen and transport workers if they struck in sympathy with the miners. Apparently there was considerable opposition to declaring a strike.

Faraday House Old Students' Dinner.—Owing to the threatened strike of the transport workers, the dinner, which would have been held on Friday, the 15th inst., has been postponed.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Scottish Centre.—The seventh ordinary meeting will be held at 7·30 p.m., at Dundee, on April 29th, when the paper by Messrs. E. Griffiths, D.Sc., and F. H. Schofield, B.A., B.Sc., entitled "Some Thermal Characteristics of Electric Ovens and Hot-plates," will be read.

North-Western Centre.—The annual general meeting was held on April 12th, at the Engineers' Club, Manchester, Mr. J. Frith presiding. The Committee's report for the year stated that 11 general meetings had been held, including the popular lecture given at the Manchester College of Technology on April 6th by Prof. Marchant, at which the attendance was about 600. At the other meetings the attendance averaged 110, and the number of speakers who took part in the discussions averaged seven.

The membership had considerably increased, the figures on April 1st being: Members, 143; Associate Members, 516; Associates, 20; Graduates, 94; Students, 375; total, 1,178, as against a total of 984 last year and 833 in the year 1918-19. In the Liverpool Sub-Centre the membership had reached 367. The Committee of the Preston Sub-Centre had decided to discontinue as a Sub-Centre on account of their meetings overlapping with those of the English Electric Engineering Society, which already covered practically the whole of the membership in Preston. Eight meetings of the Students' Section had been held.

The report was adopted on the motion of the chairman, who described it as highly satisfactory. He was especially pleased that the increase of membership was mainly among the students, whose number had increased during the year from 222 to 375. A request signed by 56 members had been received by the Committee that informal meetings should be held during the session at which the younger members would be encouraged to speak, no reports being published. That request would be given careful consideration.

Votes of thanks were passed to the retiring chairman, the hon. secretary, Mr. Ellis, and the other officers. The election of officers for the next year resulted as follows:—

Chairman: Alderman W. Walker.

Vice Chairmen: Mr. A. S. Barnard and Mr. G. A. Juhlin.

Hon Secretary and Treasurer: Mr. A. G. Ellis.

New Members of Committee: Messrs. A. G. Livesay, C. D. Taite, R. Townend.

North-Western Students' Section.—The annual meeting of this Section was held at Manchester, on April 5th; Mr. S. Chadwick was in the chair, and was re-elected chairman. A satisfactory account was given of the Section, which embraces Lancashire and Cheshire (excluding Liverpool), and numbers about 250 members. Mr. W. T. Anderson gave a lantern lecture entitled "From factory to face, or the history of a colliery cable."—*Manchester Guardian.*

Liverpool Sub-Centre of the North-Western Centre.—In the absence of Sir William Noble, Mr. T. E. Herbert read the paper on "The Long Distance Telephone System of the United Kingdom," before the Liverpool Sub-Centre on April 11th. The meeting was the largest of the session, with an attendance of 140. Mr. A. J. Eames opened the discussion, and dealt in a general way with the telephone system. Mr. Harrison briefly discussed the paper, and related one or two telephonic experiences of his recent American tour. Mr. Halttum criticised some of the figures in the appendices, and suggested modifications which, in his opinion, would make the tables more complete. Dr. Marchant discussed the paper, and said how pleased he was to observe such a large audience, which more or less confirmed the opinion expressed in

his chairman's address, when he indicated that he thought the Sub-Centre should develop and encourage discussions on telephonic subjects. Mr. Mercer discussed the paper from the cable manufacturers' point of view. Mr. Pratt outlined some developments, and made sympathetic reference to the work of the late Mr. C. E. Hay. Mr. Bolton asked some questions relating to Continental practice. Mr. Herbert replied to the discussion in detail in a manner which was very much appreciated by the audience.

North-Eastern Centre.—A meeting of the members of the Centre was held at Armstrong College, Newcastle-on-Tyne, on April 11th. It had been expected that Mr. E. A. Watson would be present to read his paper upon "Magnetos for Ignition Purposes in Internal Combustion Engines," but, unfortunately, the disorganisation of the train service consequent upon the miners' strike prevented his getting to Newcastle, he having lost a connection at Birmingham. Under these circumstances, Mr. Thomas Carter kindly contributed a "Few Notes on Power-Factor Correction," which were listened to with interest.

Conjoint Board of Scientific Societies.—The Board has decided to discontinue the publication of the annual calendar and fortnightly *Bulletin* of scientific meetings ("Diary of Scientific and Technical Societies"), owing to the heavy printing liabilities incurred.

S.A. Institute of Electrical Engineers.—In the course of his inaugural address, delivered on February 17th last, Mr. L. B. Woodworth (President) commented upon the Institute's progress. In 1910 the total membership was 205, and the bank balance £189. At the end of 1920 the Institute had 489 members and £1,095 in funds, having given, in addition, £500 in aid of the Associated Scientific and Technical Societies of South Africa, of which body Dr. A. J. Orenstein was recently elected President.

Association of Mining Electrical Engineers.—In a paper read before the Ayrshire Branch of the Association, Mr. G. Müllen, colliery manager, Irvine, said one of the great causes of reduced output in mines was the fact that so few of the men in charge of mechanical coal-cutters were competent for the work. Through neglect, machines frequently broke down, with the result that men were thrown idle. The machines depreciated in value, and output was greatly reduced. The men were not to blame, because they had never had an opportunity of learning and understanding the mechanism of the machines under their charge. Men should be taught the function of each part of the machine and its proper care, but mine owners and miners' leaders seemed quite indifferent to the practical education of the workmen.

Royal Institution.—On Thursday, April 21st, Mr. H. S. Foxwell begins a course of two lectures on "Nationalisation and Bureaucracy." The Friday evening discourse on April 22nd will be delivered by Sir James Walker, on "Electro-Synthesis in Organic Chemistry."

Institute of Physics.—The meeting to inaugurate the Institute of Physics will take place on April 27th, at 6 p.m., in the Hall of the Institution of Civil Engineers, Great George Street, Westminster. Sir Richard Glazebrook, K.C.B., President, will preside, and Sir J. J. Thomson, O.M., will deliver an address. Mr. A. J. Balfour is expected to be present and to extend a welcome to the Institute. Non-members of the Institute or of the Societies associated with it may obtain tickets of admission on application to the Secretary, 10, Essex Street, Strand W.C.2.

Paisley Association of Electrical Engineers.—The annual general meeting of the Association was held on April 6th. The secretary's and the treasurer's reports were read and approved. The following office-bearers and committee were appointed for next session:—President, Mr. W. R. Scott; vice-presidents, Messrs. Joseph Savage, R. W. Dobson, and W. R. Bruce; hon. secretary, Mr. E. D. Anderson, B.L.; hon. treasurer, Mr. J. M. Barbour; and committee, Messrs. D. E. Craven, D. M'Kay, James Orr, W. Blair Smith, and George Wright.

Birmingham and District Electric Club.—At a meeting held on April 9th, Mr. Frank Forrest, M.I.E.E., gave an address upon the Birmingham municipal electricity supply undertaking. He traced its growth, and also referred to the delimitation of areas under the Electricity (Supply) Act, 1919.

Institution of Production Engineers.—The second meeting in connection with the formation of the above Institution was held on April 2nd, when Mr. Cecil F. Hammond, of Coventry, presided over a large attendance.

In an opening speech, the Chairman referred to the way in which the Provisional Council came into being, and added that they, the Provisional Council, had found it necessary to constitute themselves under a memorandum of association into an incorporated Institution, and under the proposed articles it would be seen that the Council had power to add further members up to 26.

After a thoroughly interesting discussion a resolution was put to the meeting and unanimously carried: "That the memorandum of association be accepted."

Subsequently the meeting discussed in detail the proposed articles of association and by-laws as provisionally drafted by the Council.

The proprietors of *Engineering Production* are to be approached with a view to making that journal the official organ.

Midland Institute of Mining, Civil and Mechanical Engineers.—At a meeting of the Institute, held in Doncaster, on April 2nd, Mr. S. Diggle read a paper on "Electrical Haulage and the Elimination of Pit Ponies." In his paper, the author gave particulars of the improvements effected in this direction at the pit, of which he has charge. The substitution of electrical for horse haulage gave vastly improved service at a lower cost.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

According to the daily Press, Prof. Einstein has accepted an invitation of the Council of the University of Manchester to give a lecture at the University during his visit to England in the near future.

Mr. S. F. Cox has been appointed managing director of Electrical Devices, Ltd., of 18-20, Collingwood Street, Newcastle-on-Tyne.

Bradford Corporation Advisory and Co-ordination Committee, last week, postponed for six months the question of salary increases for Corporation officials; the proposals involve an addition of £6,330 to the expenditure on wages and salaries.

Bury Town Council, despite opposition, has decided to increase the salary of its tramway manager from £500 to £600 per year, in addition to bonus.

Mr. Horace I. Palmer, chief traffic assistant, has been appointed traffic superintendent of the Liverpool Corporation Tramways at £650 per year. Mr. J. Wood, chief traffic clerk, has been promoted to the position of chief traffic assistant at £500 per year.

Last week, at the Halifax Tramways Club, the employés of the department gathered to present a silver tray and case of cutlery to Mr. J. C. Caird, late tramway manager, whose place has had to be filled, owing to his continued ill-health. For the same reason Mr. Caird was not able to be present, but Mr. W. M. Rogerson, electrical engineer, undertook to convey the gifts to him, and on Mr. Caird's behalf, thanked the gathering.

Nelson Town Council is asking all Corporation servants to forgo any increases of salary to which they may be entitled. Wallasey Town Council has decided that all war bonuses shall cease at the end of July. In other districts there is determined opposition to any further increases of salary or wages.

The friends of Mr. A. J. Davis, electrical engineer, Pigeon House power station, Dublin, have presented him with a wallet of Treasury notes and other gifts on his leaving for Canada.

Mr. C. Sylvester, who was until recently situated at Jamaica, is now holding the position of Lecturer in Electrical Engineering at the Municipal Technical School at St. Helens.

Mr. C. J. Elliott, chief electrical engineer to the Calico Printers' Association, Ltd., was married on 8th inst. to Miss Winifred Pegler, of Cheltenham.

Mr. E. J. H. Bluett, A.M.I.E.E., electrical engineer to the Ascot District Gas and Electricity Co. since the inauguration of the electricity supply in 1907, has resigned from that position and entered into partnership with Messrs. John Drake & Co., electrical engineers, Sunningdale, with branch establishments at Egham and Englefield Green.

Obituary.—Mr. G. Braulik.—We regret to record the death, on April 5th, after a few weeks' illness, of Mr. George Braulik, of 8, Lambeth Hill, E.C.

Mr. Bertram Blount, F.I.C.—We regret to read in the *Times'* "Deaths" column that Mr. Bertram Blount, F.I.C., passed away on April 9th, at 48, Bedford Gardens, Campden Hill, London, at the age of 54 years. Mr. Blount was the author of a work on "Practical Electro-Chemistry," a subject on which he was a well-known authority.

Wills.—Mr. James Keith, managing director of James Keith and Blackman & Co., Ltd., left £115,160 gross, and £107,630 net personalty.

The Earl of Galloway, a director of W. T. Henley's Telegraph Works Co., Ltd., left £28,446.

NEW COMPANY REGISTERED.

Electrical Devices, Ltd. (174,038).—Private company. Registered April 4th. Capital, £1,000 in £1 shares. To carry on the business of dealers in electrical supplies, accumulators, engines, chassis, cables, wires, lamps, dynamos, carbons, &c. The subscribers (each with one share) are: J. R. Cox, 17, Douglas Road, N.1, manufacturer; W. Dunscombe, 11, Melfort Road, Thornton Heath, electrical engineer; A. T. Dowles, 79, First Avenue, Manor Park, E.12, accountant. The first directors are not named. Solicitor: E. L. D. Zeffertt, 17, Coleman Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Berry's Electric, Ltd.—Mortgage dated March 21st, 1921, to secure all moneys due or to become due from company to London Joint City & Midland Bank, Ltd., charged on certain freehold land, buildings, machinery, &c., in Spring Road, Yardley, Birmingham.

Jackson Electric Stove Co., Ltd.—Satisfaction in full on June 17th, 1920, of debentures dated July 23rd, 1913, securing £500.

Gratze, Ltd.—Debenture dated April 1st, 1921, to secure £2,000, charged on company's undertaking and property, including uncalled capital. Holder: R. W. Nuttall, Briarfield, Walton-on-the-Hill.

Switchgear & Cowans, Ltd.—Issue on March 31st, 1921, of £1,000 debentures, part of a series already registered.

Alliance Electrical Co., Ltd. (166,835).—Capital, £10,000 in £1 shares. Return dated February 26th, 1921. 3,854 shares taken up, 10s. per share paid up in cash and 10s. per share credited as paid. Mortgages and charges: Nil.

CITY NOTES.

Urban Electric Supply Co., Ltd. For the year 1920 the gross profits amounted to £90,979, as compared with £59,824 for the previous year. £86,685 is carried to the net profit and loss account. Interest, debenture stock redemption, and income tax absorb £60,845. £1,322 is brought forward, £25,000 is placed to reserve for depreciation, and £2,163 is carried forward. The report states that the directors feel that despite the substantially improved results shown, they are not yet in a position to recommend the resumption of a dividend on the cumulative preference shares, the whole of the company's cash resources being still required to meet its current needs. The enlarged powers which the Electricity Commissioners and the Ministry of Transport are seeking to enable them to revise maximum prices irrespective of the limitations imposed by the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, have not yet been obtained, and consequently those undertakings which have been able to obtain only the inadequate relief afforded under the terms of that Act are still restricted thereto.

The following table shows the connected load in kW and profits for the years 1919 and 1920:—

	Load in kw.		Profits.	
	1919.	1920.	1919.	1920.
Hawick	3,816	4,146	£5,608	£10,758
Stamford	1,824	1,934	2,408	1,858
Weybridge and Walton	4,170	4,470	4,990	5,601
Godalming	2,032	2,192	1,715	3,314
Twickenham and District ..	11,416	12,677	11,919	22,319
Dartmouth	1,121	1,189	1,889	1,587
Camborne, Redruth & Cornwall..	8,272	9,662	7,084	4,735
Newton Abbot	1,895	2,097	3,528	2,840
Grantham	1,255	2,439	6,995	7,069
Glossop	1,546	1,709	4,936	6,425
Berwick	1,250	1,386	loss, 750	2,449
Caterham	1,243	1,389	1,607	1,950
Newbury	1,459	1,593	716	5,420
Cornwall Co.	—	—	7,200	7,200
Penzance Co.	—	—	169	621
Totals	43,299	46,882	£59,784	£83,707

Llanelly & District Electric Lighting & Traction Co., Ltd.—At the annual meeting held last week Mr. A. R. Holland, who presided, said that the year had been one of great difficulty, but they were enabled to recommend the maintenance of the dividend as in 1919. Their power business continued to develop very satisfactorily, and many new and important consumers had been connected. The business was sufficient to fully and profitably employ the new plant, and given normal conditions the prospects were good. The directors had under consideration the terms of a proposed new issue of capital.

W. Canning and Co., Ltd. The report for 1920, submitted at the first annual meeting, held yesterday, at Birmingham, shows that the balance of profit, after charging all expenses, including directors' and management remuneration, maintenance and depreciation of properties, plant and fixtures, and also after providing reserves for estimated income tax, corporation tax, and excess profits duty, is £24,353, from which has to be deducted the proportion of profit to June 1st, payable to the vendor under the agreement for sale and purchase, £9,956, leaving a balance of £14,397. A dividend on the ordinary shares at the rate of 7½ per cent. per annum as from the date of allotment of shares, June 22nd, 1920, up to December 31st, 1920, less income tax, requires £8,285; it is proposed to write off half the preliminary expenses, £4,660, and to carry forward £1,452. The sales for 1920 were the largest in the history of the business, but the serious trade depression, with its accompanying heavy fall in values, adversely affected the profits during the latter part of the year. The new London premises have now been adapted to the company's special requirements, and have been occupied since November last. The old London leasehold property has been sold satisfactorily. The company has acquired extensions to its freehold properties in Birmingham, but no building development has been put in hand.

Folkestone Electricity Supply Co., Ltd. During 1920 there was an increase of 16,981 8 c.p. lamps, making 198,808; this was the largest increase the company has experienced. Including the receipts from hired installations, the profit on revenue accounts from the three undertakings was £14,918, an increase of £611. Adding £939 brought forward, and interest on investments, &c., and allowing for interest on debenture stock and bank overdraft and dividend on preference shares, the balance is £10,226. Out of this £7,019 has been carried to depreciation fund, making it £64,324. Dividend at the rate of 4¾ per cent., less income tax, on the ordinary shares for the year; carried forward £832. The payment of the dividend recommended is subject to the consent of the Electricity Commissioners which has yet to be obtained. The directors have under consideration the question of carrying out in the immediate future a substantial capital outlay in connection with plant extensions, to cope with the extra demands made on the company's station. Negotiations have been entered into with the Air Ministry for the supply of electricity to the Hawkinge Aerodrome, a contract has been prepared in connection with the public lighting of Cheriton, and other contracts are being negotiated, in addition to substantial increases made from time to time in connection with ordinary private supplies. To cope with these demands it is necessary to lay down further plant, which will entail a considerable expenditure. Under these circumstances the shareholders will be asked at the meeting to-day at Folkestone to pass a resolution authorising the directors to raise or borrow an additional sum of £50,000 over and above the present issue sanctioned of £100,000. It is not intended to raise the whole of this sum at once, and for present purposes a temporary advance of not exceeding £20,000 will meet the company's requirements.

France. The report of the Tramways de Rouen Co. states that the receipts for the year were 9,230,430 fr., and the expenses 9,700,656 fr., leaving a gross deficit on the working of 417,260 fr., which, adding thereto the balance of interest and other accounts, and the service of the loan, brought the deficit up to 819,877 fr., less the carry over of the foregoing year of 178,694 fr., leaving the net debit balance 646,183 fr. To remedy this shortage on the working, the company had obtained from the superior authority, with the agreement of the City of Rouen, the approval of various modifications in the system of lines and an increase on the fares. These modifications were, however, only of a provisional and inadequate character, and to further ease the situation the City of Rouen had made various advances to the company, the total of which up to December 31st, 1920, had risen to 1,085,925 fr. Further steps had likewise been taken with the city authorities to establish a tariff régime more in accordance with existing economic conditions. As an outcome of the rise in the price of coal and the resulting increased cost of electrical energy, the working of certain of the tramway lines on steep slopes had become so burdensome that it had been decided, with the assent of the city, to suspend these services until the cost of electricity had sunk to a level allowing of their working without loss to the company.

Prospectus.—*Central Electric Supply Co.*—This company has this week been offering £500,000 8 per cent. secured and guaranteed notes, which are unconditionally guaranteed as to principal and interest by the St. James's & Pall Mall Electric Lighting Co. and the Westminster Electric Supply Corporation. The price of issue is 97, and the notes are repayable in April, 1926, or earlier on specified terms. As our readers are already aware, the proceeds are required for the purpose of new plant and machinery and for extensions at Grove Road bulk supply station. The list was to close yesterday, Thursday.

City of London Electric Lighting Co., Ltd.—This company's new issue of £300,000 second cumulative preference shares and £94,050 ordinary (all £1 shares) was to have been published on Monday, but was postponed until Wednesday on account of the strike.

Sweden.—The directors of the Elektriska A.B. Eck of Partille report a loss of 291,000 kr. in 1920, which is covered by a transfer from the reserve fund. Notwithstanding the labour dispute for two months at the beginning of the year, the working results were favourable, but they were dislocated by the unprecedented fall in prices of all kinds of materials and manufactures towards the close of the year. In 1919 a loss of 905,000 kr. was incurred, as it was found necessary considerably to write down the stocks of goods and installation materials. This was met partly by the absorption of the balance forward and partly by transfer from the reserve fund.

The Austrian Felten & Guilleaume Co.—The accounts of Felten & Guilleaume, Fabrik Elektrischer Kabel, Stahl, und Kupferwerke A.G., of Vienna, indicate net profits of 28,520,000 crowns for 1920, or 24,480,000 crowns more than in the previous year, and the dividend is at the rate of 30 per cent., as against 17 per cent. It has been decided to increase the share capital from 20,000,000 to 50,000,000 crowns.

Monte Video Telephone Co., Ltd.—Interim dividend on the ordinary shares for the half-year at the rate of 6 per cent. per annum, free of tax.

Lancashire Dynamo & Motor Co., Ltd.—The financial Press records a final dividend of 6¼ per cent. on the ordinary shares, making 10 per cent. for the year.

Castner-Kellner Alkali Co., Ltd.—The directors announce a dividend at the rate of 16 per cent. per annum for the past half-year.

Belgium.—La Société des Cableries et Trefileries Leigeoises, of Renory-Angleur, is paying a dividend of 6 per cent. for the last financial year.

Stock Exchange Notices.—The undermentioned have been order to be officially quoted:—

Henley's (W. T.) Telegraph Works Co., Ltd.—250,000 ordinary shares of £1 each, fully paid, Nos. 400,001 to 650,000.

English Electric Co., Ltd.—A dividend of 8 per cent., less tax, on the ordinary shares is announced.

Reyrolle & Co., Ltd.—A dividend of 12½ per cent. on the ordinary shares is announced.

Direct United States Cable Co., Ltd.—Final dividend of 4s. per share, less tax, making a total of 4 per cent. for the year.

STOCKS AND SHARES.

TUESDAY EVENING.

PRICES of Stock Exchange securities have been blown about by every breath of idle rumour concerning the coal crisis and the various conferences that have arisen therefrom. On this (Tuesday) evening the markets left off in a somewhat nervous condition, with gossip taking an unfavourable view of the outlook. Investment stocks, however, are well maintained, and Government issues improved, on the assumption that cheaper money is close at hand. This had a strengthening effect upon the War Loan and, through its agency, upon the other purely investment securities. But the general tendency was inclined to heaviness, and business dwindled to a mere shade of what it was, say, twelve months ago.

In the railway market, Underground Electric Income Bonds have risen another 2 points to 69½, making 6 within a fortnight. The £10 shares, however, slipped back to 1½. What the Underground group would do in the event of a strike is naturally a topic of eager debate. It is recalled that during the strike of October, 1919, the District and some of the other tube lines managed to maintain a volunteer service, but unless report spoke wrongly, a good deal of damage was caused by the operation of complicated machinery in unskilled hands. The Tube group, however, has always stood more or less apart from the others, and while steam stocks weakened in price, the Underground Income Bonds, as already mentioned, have further advanced. Metropolitans are 2 better at 24½, while Districts added the fraction at 14½. Central London deferred stock at 22½ is up 5; the Assented deferred remains at 43½.

Declaration by the English Electric Co. of 8 per cent. dividend on its ordinary shares has come as a pleasant piece of news for this particular department. Some had feared that the dividend would be cut to 5 per cent. The report is awaited with no little interest. There is, however, no particular change in prices of manufacturing shares. General Electrics are easier at 22s. Both classes of the company's preference—the 6½ per cent. and the 7½ per cent.—are 6d. lower at 18s. Babcock & Wilcox receded to 26s. 3d.

It may be useful to point out that English Electric 8 per cent. 6-year Notes, which were issued at 98, can be bought at 95½ with a full half-year's interest in July next. They are redeemable in 1927 at 103, or can be paid off after 1923 at the same price. The company's 5½ per cent. sinking fund first mortgage debentures are obtainable at 83½, with interest in January and July, affording a yield of £6 12s. per cent. These are repayable in 1940 at 103, by a cumulative sinking fund of 2½ per cent. per annum. The Central Electric Co. has published its prospectus of £500,000 8 per cent. secured and guaranteed Notes offered at 97 per cent. They fall due in 1928 unless redeemed earlier at a premium. The St. James's & Pall Mall Electric Light Co. and the Westminster Electric Supply Corporation guarantee the notes, and the security is admirable. The only objection which can possibly be raised is the fact of redemption occurring five years hence, when, of course, money may possess a value very different from what it commands to-day. In other words, the investment is a short-dated one, although this in the eyes of a good many people will be an advantage and no drawback, inasmuch as the brief tenure of the Notes will have the effect of keeping up the price during the interval. The City of London prospectus of 600,000 8 per cent. second preference and 94,050 ordinary shares to be offered at 20s. and 22s. 6d. respectively has not made its appearance up to the time that these paragraphs are written. The underwriting was finished, however, some days ago, and the preference underwriters received 3 per cent. commission with ½ per cent. over-riding. Sub-underwriters receive, of course, a little less.

	Gross revenue.		Gross expenses.	
	1918.	1920.	1918.	1920.
Brompton	£56,482	£103,372	£24,984	£59,469
Charing Cross, W.E....	151,240	311,045	66,866	208 214
Do. City...	149,819	418,746	80,639	355,061
Chelsea	72.602	115.404	35,052	73,530
City of London ...	311,822	649,391	139,724	438,132
County of London ...	255,670	698 625	120,534	454,372
Kensington and K. ...	81 859	127,141	47,679	97 107
London	162 854	372.230	91.101	272,743
Metropolitan	217,605	516,594	111.317	318,638
St. James'	146,161	227.939	94,010	187,012
South Metropolitan ...	6[illegible],635	193,037	24,065	116,216
Westminster	256,800	401,040	154,254	315,726

Prices of the various cable stocks are a trifle less steady than usual, owing to the fact that a few shares have come in at a time when investors, even in these shares, are not particularly anxious to increase their engagements. However, as soon as the strike clouds are rolled away, there is every reason to suppose that the strength of the market will be resumed. The firm spot in this group is Marconi ordinary. Humorists attribute the month's rise to the fact that the Italian Ambassador, Senor de Martino, paid a visit to the Stock Exchange last Monday. A more practical reason for the improvement is, of course, that mentioned on several occasions here, namely, that the optimists expect a payment of 20 per cent. dividend to be declared shortly. If this is done, it would make 25 per cent. for the year, the same as that which was paid in the preceding twelve months. With the price of the parent shares, that of the preference has also strengthened to 2½. Canadian Marconis are also better at 6s. 9d., while Radio Common keep about 9s. and the preferred at 11s. 6d.

The accounts of the various electricity supply companies are now all published, and it is possible to compare the figures with those of the preceding years. We think it may interest a good many readers to notice how gross revenue and expenses have both gone up since the outbreak of war. Therefore, taking the figures for 1913, we add those just published in respect of 1920, and they compare as shown in the accompanying table.

Business in this section is so quiet that the only alteration on the week is a fall of sixpence in City of London ordinary shares.

In the foreign traction department, Brazil Tractions dropped 2 to 35. What little French support had been forthcoming for these shares is now withdrawn, and the market is dull. Mexicans, on the other hand, are somewhat better, despite absence of news from Mexico. Mexican Light & Power First Bonds are 2 up at 62. There are also improvements in Pachuca and several other bonds in Mexican utility companies. Anglo-Argentine Tramways second preference receded to 3.

Metropolitan-Vickers ordinary are lower at 18s. 6d., the preference remaining about 35s. Vickers and other armament shares have strengthened to a modest extent. The rubber share market remains moribund. In the annual report of the Stock Exchange, just issued, it is shown that the Managers spent £5,891 upon "electric power, working expenses and maintenance." This is nearly £4,000 more than the same item absorbed in the previous year. It has been found necessary to renew the electric installation throughout the Stock Exchange, and the carrying out of the work is responsible for much of the increase in the charge under this head.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1919.	Dividend 1920.	Price April 12, 1921.	Rise or fall.	Yield.
HOME ELECTRICITY COMPANIES					
Brompton Ordinary	12	12	6	—	£10 0 0
Charing Cross Ordinary	7	8	8¾	—	10 6 6
do. do. 4½ Pref.	4½	4½	9¾	—	8 3 8
Chelsea	4	6	9	—	10 0 0
City of London	13	14	23/3	—6d.	12 0 10
do. do. 6 per cent. Pref.	6	6	15/-	—	8 13 4
County of London	8	8	7½	—	10 9 10
do. do. 6 per cent. Pref.	6	6	8	—	7 10 0
Kensington Ordinary	7	9	4½	—	10 18 2
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref	6	6	2½	—	10 18 2
Metropolitan	6	7	8¾	—	10 15 4
do. 4½ per cent. Pref.	4½	4½	3½	—	7 13 2
St. James' and Pall Mall	12	12	6	—	10 0 0
South London	6	—	2½	—	9 2 10
South Metropolitan Pref.	7	7	15/9	—	8 17 10
Westminster Ordinary	10	10	5½	—	9 15 2
TELEGRAPHS AND TELEPHONES.	1918	1919			
Anglo-Am. Tel. Pref.	6	6	7½	—1	7 11 0
do. Def.	33/6	1½	15/-	—	9 9 6
Chile Telephone	8	8	5½	—	8 6 8
Cuba Sub. Ord.	7	7	6¾	—	10 15 4
Eastern Extension	10	10	16	—	6 5 0
Eastern Tel. Ord.	8	10	160	—	6 5 0
Globe Tel. and T. Ord.	8	10	15½	—	6 6 0
do. do. Pref.	6	6	9	—	6 13 4
Great Northern Tel.	22	21	22	—	10 0 0
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2⅞	+ ¼	—
Oriental Telephone Ord.	10	12	2⅞	—	*5 9 7
United R. Plate Tel.	8	8	6¼	—	6 10 8
West India and Panama	1/8	Nil	1/16	—	Nil.
Western Telegraph	8	10	16	—	*6 5 0
HOME RAILS.	1919	1920			
Central London Ord. Assented	4	4	44½	—	9 0 0
Metropolitan	1½	1½	2⅛	+2	6 2 4
do. District	Nil	Nil	14½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	1⅞	— ⅛	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	69½	+2	2 17
FOREIGN TRAMS, &c.	1913	1919			
Anglo-Arg. Trams, First Pref.	Nil	8½	2¾	—	10 9
do. do. 2nd Pref.	Nil	Nil	8	—	Nil
do. do. 5 % Deb.	5	5	59½	—	8 8 0
Brazil Tractions	Nil	Nil	35	—2	Nil
British Columbia Elec. Rly. Pfcs.	5	5	55	—	9 1 10
do. do. Preferred	2½	5	64½	—	*8 14 0
do. do. Deferred	Nil	8	51½	—	*11 17 6
do. do. Deb.	4½	4½	56½	—	7 10 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	86	—	Nil
do. 6 per cent. Bonds	Nil	Nil	21½	—	Nil
Mexican Light Common	Nil	Nil	12⅞	—	Nil
do. Pref.	Nil	Nil	18	—	Nil
do. 1st Bonds	Nil	Nil	62	+2	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	2/-	— ⅛	6 10 0
British Aluminium Ord.	10	10	17/6	—	11 8 6
British Insulated Ord.	12½	15	1/-	—	9 12 0
Callenders	25	15	1/-	—	10 18 2
„ 6½ Pref.	6½	6½	17/6	—	7 8 7
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	10	10/-	—	—
do do. 5 per cent. Deb.	5	5	70	—	7 2 10
Electric Construction	10	10	15/9	—	12 14 0
English Electric	—	8	11/-	—	14 11 0
Do. Pref.	—	6	13/-	—	9 4 8
Gen. Elec. Pref.	6½	6½	18/-	—6d.	7 4 5
do. Ord.	10	10	22/-	—6d.	*9 1 10
Henley	25	15	1/-	—	11 8 6
do. 4½ Pref.	4½	4½	8½	—	6 18 6
India Rubber	10	10	½	—	—
Met.-Vickers Pref.	—	8	1½	—	9 2 10
Siemens Ord.	10	10	1	—	*9 15 8
Telegraph Con.	20	20	20½	—	*5 18 8

* Dividends paid free of Income Tax.

THE MEASUREMENT OF FREQUENCY AND SPEED.

Some Everett-Edgcumbe Instruments.

In almost every branch of engineering the measurement of the speed of rotating machinery is a matter of importance, but in none is accuracy so essential as in electrical engineering. This being so, it is curious how limited is the number of instruments available for the purpose, more especially when it is desirable, as is so often the case, for the speed to be observed at a distance from the machine in question. This condition at once rules out the revolution counter and the mechanical tachometer, which, however useful in themselves, are necessarily limited in their applications.

One of the most useful of tachometers is the resonance

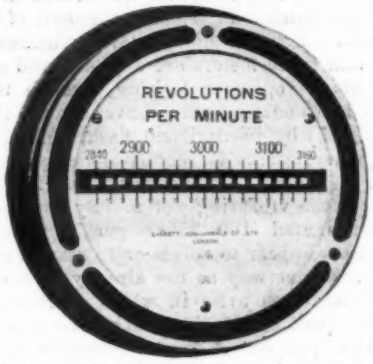


Fig. 1.—Resonance Pattern Tachometer.

pattern, in which a "comb" of tuned steel reeds is rigidly attached to the machine whose speed is to be determined. Since the vibration of a running machine is due solely to a want of balance, it follows that the frequency of vibration is equal to the speed of revolution, and if it can be transmitted to a set of tuned reeds (see fig. 2), the one whose free period is equal to that of the vibrations will be set swinging in resonance, and forms a ready means of determining the speed. In practice it is only necessary to mount the instrument on the machine itself, no form of transmission being required. These instruments, one of which is shown

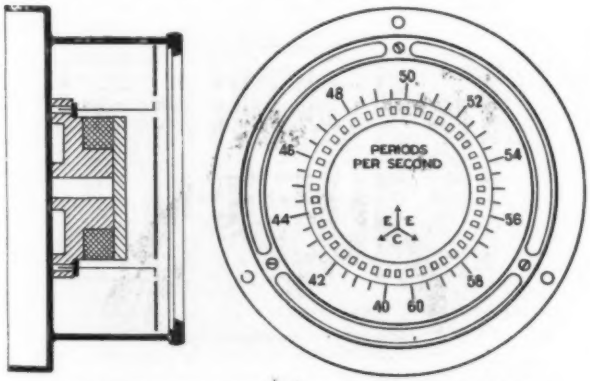


Fig. 2.—Elevation and Section of Frequency Meter.

in fig. 1, are particularly useful in connection with turbo-generators, the speed of which it is difficult to determine by any other means.

Below, say, 1,000 revolutions per minute, the reeds become somewhat "unwieldy," and it is preferable to increase the number of vibrations for each revolution of the machine. This is readily done in the case of a rotating shaft by fitting it with a cam having two, four, or any other number of projections, against which presses a small roller connected in any convenient way to the indicator, as, for example, by a stretched wire or cord. By this means speeds from the lowest to the highest can be measured with the utmost ease and precision.

Since in electrical work the speed of revolution and the frequency are so intimately connected, it may be convenient to deal at the same time with instruments for the measurement of both these quantities. The best known frequency meter is probably the resonance or vibrating reed pattern, which is unsurpassed for accuracy and permanence. It is shown in section in fig. 2. The flexible reeds, each tuned to a definite frequency, surround a central electromagnet which is excited from the source, the frequency of which is to be measured.

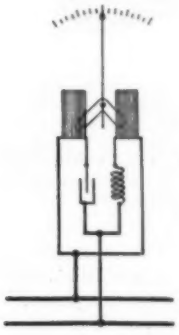


Fig. 3.

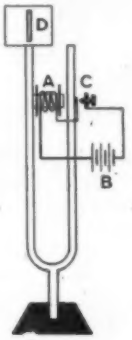


Fig. 4.

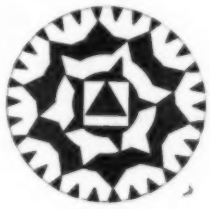


Fig. 5.

All the reeds are attracted once during each half cycle, that is to say, twice per cycle. The motion, however, is too small to be visible except in the case of the particular reed whose free period of vibration corresponds to the frequency of the current, and which is, therefore, set in resonant vibration. This is at once noticeable, owing to the fact that the reed swings from side to side so as to bridge over the circular slot in the dial at that point.

Such an instrument is extremely accurate and permanent in its indications, but is necessarily somewhat less easy to read than one provided with a pointer moving over a graduated scale. For this reason a considerable demand has arisen for a deflectional frequency meter. The connections of the Everett-Edgcumbe instrument of this pattern are shown in fig. 3. The moving element consists of a pair of soft iron needles fixed to a staff centred in jewels and carrying a pointer. The

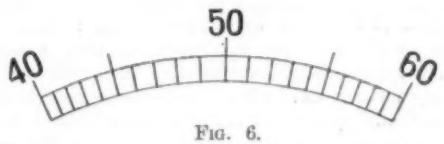


Fig. 6.

two coils, acting upon the needles, are connected—the one through a choking coil and the other through a condenser—across the source of supply. The constants of the circuits are so chosen that, at normal frequency, the action of each coil upon its respective soft iron needle is the same. Under these conditions, therefore, the pointer stands in the centre of the scale, whilst a rise of frequency is accompanied by an increase of current through the one coil and a decrease through the other, thus deflecting the pointer to the right, and *vice versa*. The result is a long and open scale having wide divisions at the centre, or normal point, but closed up somewhat towards the two ends, which is the ideal form of scale for an instrument of this class. Fig. 6 shows, half size, the scale of one of these instruments

with a range of 40-60 cycles, and from this the clearness and openness of the divisions will be apparent.

It is evident, from the principle of action just described, that by careful design any change of voltage can be made to give a corresponding change of current through each coil, thus leaving the reading unaffected. How well this condition is fulfilled in practice will be clear from the following extract from a report by the National Physical Laboratory on a 100-volt instrument:—

"The instrument was tested at 70, 110, and 150

Fig. 7.—Transmitter (Open Pattern).

volts on a circuit the wave shape of which approximated closely to a sine curve. The accuracy of the instrument at these voltages was found to be identical."

The report continues:—

"Further observations on the instrument were taken on a circuit the wave shape of which was of the form of an isosceles triangle, with small ripples superposed."

The results obtained with 100 volts on the instrument were as follows:—

Instrument reading.	True frequency sine wave.	True frequency triangular wave.
60	60.0	59.6
55	54.7	54.3
50	50.2	49.9
45	44.8	44.5
40	40.1	Not tested.

These deflectional frequency meters have been largely used for the high frequencies (up to 1,000 cycles per second) met with in wireless work, and are particularly valuable for such a purpose, since the vibrating reed pattern is less suitable, the necessarily short and stubby reeds being difficult to distinguish when in vibration.

Frequency meters can be graduated in revolutions per minute, and then afford an extremely accurate means of determining the speed of revolution of an alternator. Moreover, in order to obtain a permanent record of frequency or speed, the same principle can readily be applied to a graphic instrument.

Although not always directly applicable to industrial work, the stroboscopic method of measuring frequency and speed is of great importance, and it may be of interest to describe the use made of this method by Messrs. Everett, Edgcumbe & Co. in adjusting their frequency meters, &c. Fig. 4 shows, diagrammatically, an electrically-operated tuning fork, adjusted to give a definite frequency of 50 cycles per second. The electromagnet A, when excited by means of the battery B, draws the two limbs of the fork together and, in so doing, breaks the circuit at the contact C; the fork then springs back again, and is kept in vibration at a definite frequency, thus moving the attached slotted plate D from side to side with a definite frequency—in the case considered, 50 complete vibrations per second. By this means, an eye looking through the slot has its field of view uncovered 100 times per second, that is, once as the limbs of the fork approach one another and again as they recede.

Attached to the end of the shaft of the generator, the speed of which is to be controlled, is fixed a disk having drawn upon it a number of regular figures surrounded by a circle of 30 radial teeth, as shown in fig. 5. If this disk is rotated at a constant speed of 200 revolutions per minute, the number of teeth passing a given point each second will be $(200 \times 30)/60 = 100$, that is to say, each time the slot passes through the central position a fresh tooth is exposed to view at exactly the same spot, so that the ring appears stationary. If the speed of rotation is slightly less than 200 r.p.m., the teeth will appear to rotate backwards, and *vice versa*. If the speed is increased to 400 r.p.m. every alternate tooth will be exposed synchronously, and the disk will again appear stationary. This will recur at 600, 800, 1,000 r.p.m.—for all speeds, in fact, which are multiples of 200 r.p.m.

Similar reasoning holds for the other figures, and by noting which of them is stationary at the same time as the toothed ring, it is easy to distinguish between the various speeds which cause the latter to stand still. The stroboscopic method is employed, in this way, to give a number of definite points on the scale of a standard magneto speed indicator (described below), the transmitter of which is attached to the shaft of the alternator, and thus forms a sub-standard by means of which frequency and speed meters are adjusted and scaled.

Instead of the operator looking through the slot D (fig. 4), it is sometimes more convenient to illuminate the disk (fig. 5) by intermittent flashes of light of definite frequency. This is readily done by causing the rays from a powerful source of light to fall upon the disk through the vibrating slot D. By this means, the disk is illuminated 100 times per second, and the various figures appear to rotate or to remain stationary in exactly the same way as has already been described.

Innumerable cases arise in which it is required to measure the speed of rotating machinery at a distance, and for this purpose a magneto-electric transmitter connected to a moving-coil indicator has been developed. Fig. 7 shows the open pattern; it consists of a small magneto generator running in ball bearings and having a permanent magnet, and carbon brushes. The armature resistance is very small, and armature reaction has been reduced to a negligible quantity, so that the terminal voltage is sensibly proportional to the speed of revolution. Two wires run from the transmitter to a moving-coil indicator, which may be of either the round, sector, or edgewise pattern, and can be installed at any required distance from the transmitter, for example, in the engineer's or manager's office.

The open pattern is effectively protected from dust, but for situations liable to excessive damp or dirt the enclosed transmitter is preferable. The latter form of

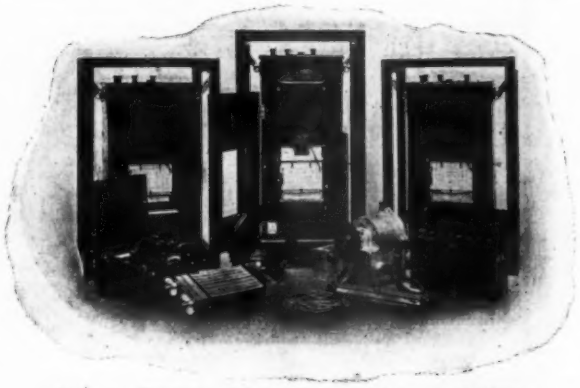


Fig. 8.—Testing Equipment for Electric Trains.

transmitter is perfectly watertight, glands and stuffing boxes being provided for the connecting leads and for the spindle.

Various methods are available for driving the transmitter. The armature speed is increased, by means of suitable gearing, to about 1,500 r.p.m., at normal speed, but in many cases it is possible to drive the magneto spindle direct from the machine under test. A short spiral coupling forms a very convenient means of so doing. If, however, this is not possible, owing

either to the speed being unsuitable or to the end of the shaft being inaccessible, a belt and pulley or a sprocket and chain are employed. The latter has numerous advantages, in particular, freedom from all slip, but for many purposes a flat belt and pulley are all that is required. Both the sprocket and the pulley are shown in fig. 7.

Needless to say, such transmitters can be employed to actuate a number of indicators situated in any convenient positions, and are also particularly well adapted for use in connection with graphers to give a continuous graphic record of the speed.

A very successful tramcar speed indicator was developed by Messrs. Everett, Edgcumbe & Co. on this principle. It consists of a transmitter belted to the axle of the car or motor and connected to a watertight indicator at each end of the vehicle. Or, if preferred,

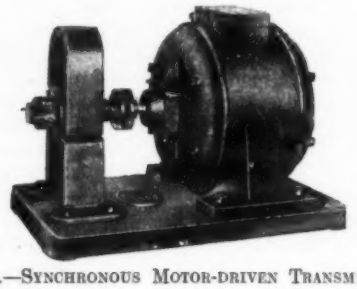


Fig. 9.—Synchronous Motor-driven Transmitter.

a single removable indicator can be employed, to be carried by the driver from end to end. Such speed indicators have proved of great value, both in preventing accidents and for training the drivers to estimate speed correctly.

In connection with electric trains, these speed indicators have been extensively used for testing purposes, either permanently installed in a test coach or as portable instruments which can be placed in the driver's cabin of any train. Fig. 8 shows an equipment supplied to the London & South-Western Railway Co. It consists of a graphic ammeter, voltmeter, and speed indicator. In order to ensure synchronism between the records each grapher is fitted with an electromagnet marking device, such that at intervals of 5 seconds a current is sent through an electromagnet on each grapher fitted with a pen, thus making simultaneous marks on all the charts. The graphers are fixed in traction suspension frames, which prevent the motion of the coach from affecting the records.

Fig. 9 shows a further application of the electromagnetic transmitter, namely, to the construction of an indicating or graphic frequency meter transmitting to a distance. The small a.c. motor is so designed that it runs at practically synchronous speed, thus driving the magneto-generator so that its voltage is directly proportional to the frequency. An advantage possessed by this arrangement is that the scale of the indicator or the chart of the grapher is evenly divided throughout. Moreover, if desired, the scale can be "set up" so as to give a particularly open reading at and about the normal point.

Such speed indicator equipments have been extensively used in connection with motor-driven rolling mills. The speed indicator is conveniently fixed on an instrument pillar placed near the driver's controller, which also carries the ammeter, voltmeter, wattmeter, &c., for the motor.

In the case of rolling mills operated on the Ward-Leonard system, two indicators are usually installed, the one showing the speed of the motor-generator set and the other that of the rolling-mill motor.

Amongst other uses to which these speed indicators and graphers have been applied may be mentioned the following:—

Measuring the propeller speed of ships (ranging from ocean liners to submarines), controlling the loom speed in cotton weaving, determining the lifting speed of cranes (a special differential arrangement has been developed which enables two cranes to maintain precisely the same speed when lifting the two ends of a single load), measuring the speed of steel rolling mills, checking the revolutions of aircraft engines, measuring the speed of rotation of testing drums for determining the flight velocity of 15-in. shells, and, at the other end of the scale, indicating the speed in "miles per hour" of roundabouts at a fair.

FIRE PREVENTION AND THE INSURANCE COMPANIES.

(Communicated.)

The appointment of a Royal Commission to "inquire into the existing provisions for the avoidance of loss from fire" is not unlikely to bring to a head the resentment which has long been simmering as regards the rates charged by the tariff insurance companies for what are known as "protected risks."

It is not easy to understand the attitude of the tariff companies towards measures having for their end the prevention of fire. From time to time various fire preventive devices have been brought upon the market, some good, some indifferent, and some bad. It is reasonable enough that the tariff companies, before according recognition to any such inventions, should require them to be tested by a committee appointed by their representative association, the Fire Offices Committee, and, if approved, as a condition of a rebate from the premium charged for the unprotected risk, should insist upon the strict observance of regulations for the maintenance of the appliances in good working order. Nor is it surprising that the Fire Offices Committee should fix this rebate with a full appreciation of the difference between theoretical and empiric values. The charge, however, which is brought against the Fire Offices Committee is that, after long years of use and experience, it persists in ignoring all evidence of protective value, and continues to demand from the owners of protected premises premiums which bear no sort of relation to the diminished loss ratio of their risks.

It would have been helpful, in considering the genuineness of this grievance, to have been able to turn to official statistics showing the exact protective value of the various appliances to which the Fire Offices Committee has, from time to time, granted its imprimatur. Had the Committee been keenly desirous of promoting the development of the science of fire prevention, one suspects that it would have found a way to keep records of this nature. Rather regrettably, however, the Fire Offices Committee has always taken up the position that the compilation of statistics of this kind forms no part of its duty to the public. It is fortunate, therefore, that as regards automatic fire alarms, probably the most scientific of all preventive devices, such records exist.

It is now a quarter of a century since the first automatic fire alarm came upon the market. It is a reasonable estimate that, at the present time, property to the value of over £100,000,000 is under protection by some form of automatic fire alarm in the United Kingdom alone. Of this amount, £46,000,000 is protected by alarms which are periodically tested and examined under contract. It is only in respect of the latter class that statistics are available. These records show that the gross premiums received from 1911 to the end of 1920 amount approximately to £1,420,000, and that out of the above premiums the fire insurance companies have only been called upon to pay as fire losses an approximate sum of £40,000, equivalent to a loss ratio of 2.83 per cent. of the fire premiums.

In the earlier years of automatic fire alarms it was customary for the tariff companies to explain their refusal to reduce their rates by declaring that sufficient

time had not elapsed to enable the law of average to operate, but the passing of years has made this contention less plausible, and to-day it can no longer be regarded as valid. Of course, it may be asked why an insurance company should not be permitted to charge what rates it pleases. Has not a disgruntled trader the option to take his business elsewhere if he is not satisfied? The reply the trader makes is that the tariff companies have to-day obtained a practical monopoly in insurance matters—at any rate, so far as the placing of the larger risks is concerned. This position has been reached partly by the action of the Legislature, which by the Assurance Companies Act, 1909, imposed restricted conditions on the formation of new insurance companies, partly by the elimination of non-tariff competition by the calculated policy of purchase and absorption of the smaller companies, and partly as a result of the natural growth of the tariff ring. Certainly it has to be conceded that competition is no longer the factor it once was in the regulation of insurance rates.

It must be borne in mind that the installation of an automatic fire alarm costs a good deal of money. It involves the whole of the premises being wired and fitted with sensitive instruments which notify any sudden accession of heat. There has to be a line running through the streets and connecting the building with the fire station. This installation has to be inspected and tested periodically to prove that it is in perfect working order. The trader who is anxious, at all costs, to avoid fire has not only to bear the expense of installing the alarm, but has in addition to pay the Postmaster-General's charges and the cost of inspection and maintenance. It must be admitted that he has a legitimate ground for complaint if he has to pay a premium fixed without reference to the material improvement he effects, at his own cost, in the fire hazard of his property.

The State has always accepted the principle that the public has the right to be safeguarded against arbitrary demands of monopolies or practical monopolies. This principle is in operation to-day as regards the rates charged for carriage by the railway companies. The Royal Commission which will shortly sit will have to consider whether the time has not come to provide the public with similar protection as regards insurance rates. In the case of the railways, the maximum rates are fixed in the first place in consultation with the Board of Trade. No railway company can increase a rate without giving notice to the Board of Trade of the desired variation. If a trader complains, it rests with the railway company to prove that the increase is reasonable. The Commissioners appointed under the Railway and Canal Traffic Acts have jurisdiction to hear and determine any such complaint, but only after the complaint has been made in the first instance to and considered by the Board of Trade. In inquiring into the complaint the Commissioners are entitled to consider all circumstances which can fairly be said to show reasonableness or the reverse.

Why should not similar protection be afforded the public as regards insurance rates? It is asking too much of human nature to expect a purely commercial undertaking such as an insurance company to hold the balance level when its interests and the interests of the public are in direct conflict. It is difficult to see what answer the insurance companies have to the demand that the grievances of traders and others should be made the subject of a reference to the Board of Trade, and, failing an amicable adjustment, should be submitted in the last resort to an independent tribunal for determination.

The Royal Commission has ample powers under the terms of its reference to report in favour of the Legislature's providing safeguards of this nature. One of the objects of the inquiry is to consider how the annual loss to the community from fire, amounting to about £10,000,000 per year, can be reduced. If the evidence submitted to the Commissioners justifies them in finding that the cure lies in the adoption of scientific methods of fire prevention, and that this remedy is held back by the refusal of the tariff companies to bring their rates into sympathetic relation with the loss ratio of the protected risks, one may reasonably expect that the Legislature will take steps to impose some measure of statutory control on insurance companies. The form of that control will, it may be hoped, follow the precedent already established in the case of railway companies.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION (INC.).

Operations during 1920.

Mr. W. O. Smith's Review of the Situation.

The annual meeting of the B.E.A.M.A. was held at the Connaught Rooms on March 17th. Mr. W. O. Smith (Elliott Bros. (London), Ltd.), chairman of the Association, presided over a good attendance of members. From the report officially provided, we learn that the chairman proposed, and Mr. Nalder seconded, the adoption of the statement of accounts, which, after the chairman had examined and explained the items in detail, was unanimously carried.

In proposing the adoption of the annual report, Mr. Smith said that when they met at last year's annual meeting they were hopeful as to the future, for after the prolonged strike of the moulders, which adversely affected every manufacturer, a settlement had lately been arrived at, and they were again busy clearing off arrears of work which had accumulated during the strike, and making plans for the future. They had already begun to think that their troubles were really over, and saw before them a vista of renewed manufacturing activities which were to compensate them for all the hardships endured during the war period. He thought that nobody could deny that the electrical industry, as a whole, was to-day faced with a more difficult position than, perhaps, at any previous epoch of its existence, and there did not appear to be much definite sign of improvement at present. Export business, especially, was at a low ebb, for how could they compete with their late enemies, the Germans, when the German could afford, largely owing to the exchange, to sell their wares in other countries at something like one-half of the prices of British manufacturers? He dared say most of their members had experienced this difficulty in some shape or form, and, therefore, he did not propose to enlarge on it in any way. The tone of the Stock Exchange was one of the best indications of the state of trade of this country. It had been depressing for some time past to look at the daily quotations, and to see that the values of nearly all securities had been dwindling and sliding in the downward direction. It was perfectly true that for the last week there had been an improvement, but they were told by experts that this was only temporary, and that bottom had not even yet been reached. Let them hope they might be wrong. The fall in values had been especially heavy in all industrials dealing with engineering, and it was to be feared that until there was some stability in exchange established by international agreement, and protection against the stream of cheap foreign imports, the British manufacturers would be at a great disadvantage, and our late enemies would win back in commerce that which they lost in war.

He wondered if members present read carefully the speeches of the chairmen of the leading British banks at the recent general meetings. He cited the banks because they had connections with all the manufacturing concerns in this country, and, therefore, had a knowledge of all branches of trade. The speeches were quite interesting reading, although there was a strong vein of pessimism in evidence in all of them. The chairmen did not all agree as to the cause of the present position. One appeared to attribute it to E.P.D., another to instability of exchange, another to restriction of output by workpeople, another to the large increase in wages, and yet another to extravagance and unfair treatment on the part of the Government. It seemed to him, however, that no one of these causes alone could be the reason of the trouble, but rather the cumulative effect of these and other causes, such, for instance, as the unsettled condition of the coal mining industry, on which the prosperity of this country depended to so large an extent, and further, to the fact that after the strain of the war, and the anxieties of that period, there followed a period of exhaustion and inaction, from which we had not, even up to the present, quite recovered. In his view, before the country generally and the electrical industry in particular, could be brought up to a state of efficiency again, harmonious working between employer and employed was

an absolute essential. The employer must pay a fair and reasonable wage, and the employed must be prepared to give a full day's work for a full day's pay, and must also realise that the excessive wages which the employed extracted, directly or indirectly, from the Government in time of emergency, could not be continued now that the industries had reverted to private enterprise, and severe competition had to be met. It was up to the workpeople to decide whether they wished to be employed or unemployed; if they insisted on extracting the last penny from the employer, only unemployment could result. There was no doubt that unemployment was still on the increase at the present time. From the newspapers it appeared that the workpeople in some industries were beginning to see the effect of excessive wages, and were themselves approaching the employers with offers of reduction, rather than find themselves out of work. That, if true, was an encouraging sign.

No doubt the members of this Association would have learned with pleasure that the life of E.P.D. was ebbing fast—and there was not likely to be any mourning over its departure. Mr. Smith then asked what they, as an association, could do to meet the present situation. "It seems to me," he said, "that never before has there been such a need in the electrical and allied industry for co-operation. Although we may compete in friendly rivalry in our own country, let us present a solid front to the enemy, even if we have to make sacrifices for the moment; let us not think and act as individuals only, but rather as an association whose common aim is that of the good of the industry and its members in bringing back trade to this country."

Referring to the matter of transport, the report showed that it had largely occupied the attention of their Traffic Committee during the year, and now the Ministry of Transport was to be abolished. That did not, however, mean that any of the problems dealt with would disappear, or that the labours of the committee had been so much time wasted. The problems still remained to be solved and fought out, and it mattered little whether the party dealing with the matter in future were Sir Eric Geddes or the Railway Department of the Board of Trade. Their efforts must not be relaxed, and the committee would still continue its labours in the interests of the Association.

The chairman said that during the year a very large number of sectional committee meetings had been held, and he thanked the members of them for their work; he also, in conclusion, referred to the efficient service rendered by the large staff employed under the able guidance of the director, Mr. Dunlop.

The report was passed unanimously, after which the chairman announced the election of the following members to fill the five vacancies in the Council for 1921:—

Belliss & Morcom, Ltd.
Cole, Marchent & Morley, Ltd.
Elliott Bros. (London), Ltd.
Ferranti, Ltd.
Mather & Platt, Ltd.

Messrs. Price, Waterhouse & Co. were re-elected auditors for the year.

The Report of the Council.

The following are extracts from the report for the year 1920, adopted by the meeting:—

The Association is still steadily pursuing its objects and enjoying the full confidence and loyal support of its members.

"The business year of 1920 affords little occasion for favourable comment; for it was not very old before the numerous inquiries for engineering machinery from all overseas markets with which it opened began to change to complaints, and members to encounter difficulties.

"The taking of an order implies the giving of a date, more or less fixed, for its delivery, and that was by no means an easy matter with shops full of unexecuted home work accumulated from a five months' moulders' strike, general labour unsettlement, and shortages of all raw materials. The taking of an order also involves the giving of a price, more or less fixed. Your Association was one of the worst involuntary sufferers under a device invented elsewhere for avoiding strict definition in this matter, namely, the price-adjustment clause, which was rendered necessary by the extreme buoyancy of costs of labour and raw materials. As soon as the clause proved to be an added discouragement to buyers, who began to seek elsewhere for firm deliveries and prices, your Council, after conferences with other trade associations, discountenanced its use after January 1st, 1921.

"Probably the most discouraging of all the features which 1920 presented was the alarming discovery that Europe was in the position of the "poor man," and that the British manufacturer, burdened with the heaviest taxation per head of population in the world, was unable to help him to help himself. The Brussels Conference having accomplished little of practical value, the Government is, at the time of going to press, with the advice of experts in banking and insurance, endeavouring to apply palliatives in the form of credit schemes to enable the "poor man" to do business and to deflate his currencies; and, in the form of Parliamentary Bills for the regulation of imports, to prevent his becoming a further danger to our own industries. How these things will work out the present Parliamentary session alone will show. Meantime, the world generally and labour in particular are being again schooled in the commonplace lesson that one cannot get something out of nothing, and that more strenuous work and higher effective production for lower rewards are the inevitable results of war."

During the year the Export Committee have had the advantage of visits from Trade Commissioners and others from overseas, all of whom gave valuable and interesting accounts of the trade position and possibilities in their respective territories.

As the outcome of the application of the Overseas Committees for extended powers, a new Draft Constitution was drawn up and has been adopted with variations in different parts of the world.

Members of the Association were thereupon invited to make nominations to the Overseas Committees under the new constitutions, and it is believed that they have thus been materially strengthened for work in their respective territories, and that good results will be forthcoming.

The preparation of the proposed BEAMA Code has made good progress during the year, and the signing of contracts for its production now awaits only the settlement of certain questions of copyright and patent right.

During the year the Education Committee settled the terms of the studentships and scholarships offered by the turbine and turbo-generator sections of the Association for the study of problems of research relating to turbines and turbine-driven generators, and these were duly published. The object of these scholarships is to encourage technically trained students to fit themselves for posts on the higher staffs of engineering concerns and research institutions. Procedure has also been settled for receiving into British works properly qualified student apprentices offered by overseas Governments and educational institutions. During the latter part of the year, twelve students nominated by the Egyptian Government were so placed.

The Electrical Research Committee obtained its incorporation during the year under the title of the British Electrical and Allied Industries Research Association.* The last report of progress (September 30th, 1920) shows that there were 87 technical reports in preparation. Amongst other researches taken over are those on the corrosion of condenser tubes (carried out jointly with the Institute of Metals), the special BEAMA research into the most suitable materials for turbine blades, and the research (conducted jointly with the Institution of Mechanical Engineers) into the proper proportions of turbine nozzles.

With regard to standardisation, the old system under which the first steps towards the making of a specification were taken by the B.E.S.A., has been reversed; the preliminary work of preparing drafts on electrical subjects is now usually done by the BEAMA. For dealing more effectively with the work of standardisation, several sections have set up permanent technical committees which draft specifications to form bases on which the B.E.S.A. will build the final texts.

In addition to public business of this kind, the sections, by their technical committees, have done much useful work on the domestic side. Thus, the switchgear section has prepared a revised edition of its purchasing specification, *Slate Panels and Slabs*, and, in collaboration with the insulations section, has standardised a complete line of moulded insulating bushes for use in switchgear and allied work. The industrial instrument section has also, in collaboration with the switchgear and meter sections, drafted standard drilling centres for the ends of instrument and meter shunts. These standards will be embodied in future editions of the Association's rules. The stationary and portable accumulator sections have standardised the relative capacities of batteries at all rates of discharge, together with final voltages. Standard curves have been plotted, and these have been accepted by Government departments and other large buyers, and the curve for portable accumulators has been adopted as standard British practice by the Society of Motor Manufacturers and Traders.

The Standardisation Committee has made recommendations to the turbo-generator section on methods of declaring the efficiency and standard overloads of turbo-alternators; to the rotary converter section on the permissible ripples in the d.c. voltage of rotary converters, having special reference to the possible disturbance produced in telephone circuits; and to the gas and oil engine section on cyclic speed irregularity in its relation to parallel running of synchronous machines. The Committee has now under review a revision of the B.E.S.A. publication, No. 72/1917, *Electrical Machinery*, and it is anticipated that the observations of members of the Committee during their recent visits to America will have an important bearing on that work.

The Traffic Committee have had a very busy year in the preparation of evidence and recommendations for and in appearances before the Rates Advisory Committee, either through their own witnesses or by counsel engaged by the Federation of British Industries on behalf of their constituent associations. We quote the report at length on this subject:—

"It will be recalled that the Minister of Transport, shortly after assuming office, set up this committee (Sec. 21 of the Act) to advise him as to how he should meet the annually recurring deficit of several millions on British railway working; and that, as a consequence, goods rates were raised 112 per cent. above pre-war figures and passenger rates 75 per cent. No long time passed before the Minister found himself obliged

* Elec. Rev., December 17th, 1920, p. 797.

to call for further advice as to (1) the principles which should govern the fixing of rates and charges; (2) the classification of merchandise, and the particular rates and charges to be imposed; and other matters.

"The Rates Advisory Committee have now issued their report (Cmd. 1,098) on the first portion of their reference, viz., The principles which should govern the fixing of rates, &c.; and your Council note with satisfaction that they adopt certain principles which form part of your committee's recommendations, *e.g.*, (*a*) That a trader should pay only for services rendered by the railway companies for either station-to-station or private-siding traffic. (*b*) That rates should be computed on the basis of continuous mileage when the transit is over the lines of more than one railway company, and should be based on the 'cumulative' principle, and that the quantity constituting a consignment should be taken into consideration. (*c*) That all rates should be disintegrated, showing what is included for conveyance, service terminals, station terminals, and any other services rendered. (*d*) That the general railway classification should be revised and brought into harmony with present-day practice.

"At the time of going to press, the Rates Advisory Committee were taking evidence on the second part of their reference, *viz.*, the classification of merchandise traffic and the particular rates, charges, &c., thereon, and the railway companies have proposed revisions which, if adopted, would place many electrical articles in a higher class than hitherto. Moreover, the mileage scale of charges, hitherto enjoyed by steam and gas engines and certain other machinery, would be abolished, which means that such articles would be penalised with the heavy-weight surcharge for pieces exceeding ten tons.

"It will be necessary strenuously to oppose these amendments to the classification, and your Traffic Committee have prepared rebutting evidence and will argue for a lower classification than hitherto on certain items. They will also press for the abolition or reduction of the heavy-weight surcharges on the grounds, *inter alia*, that, with the exception of the actual conveyance, the trader usually performs all the other services, such as loading, unloading, &c., in this connection.

"Your council issued on April 27th a memorandum prepared by your Committee for the guidance of members in dealing with the increased rates and charges put into operation on the interim recommendations of the Rates Advisory Committee; and it was evident from the replies received from members that this served a very useful purpose and enabled members to check the accounts of the railway companies, which at that time were not prepared upon any uniform plan.

"Your Committee have also advised members from time to time on charges for special trucks, the proper classification of various items, loss or damage in transit, demurrage, consignment notes, &c."

Legal business on conditions arising during the year was practically normal, the money value of such contracts as called for expert advice being about three-quarters of a million sterling, most of them being settled without friction of any kind and to the satisfaction of purchasers.

The I.E.E. Joint Committee of Revision referred to in the last report began work on the amendments proposed by the Association to the text of the model conditions, and accepted most of them. The just counterpoise of the buying and selling interests on the committee, however, resulted in the production of several amendments by the former, which has delayed the issue of the report. Negotiations are proceeding with Government departments as to their adoption of standard forms of conditions, the main point of difficulty being the arbitration clause.

The British Electrical Development Association reports a steadily increasing membership. This now includes 102 municipalities and 25 supply and power companies. Members are strongly recommended to acquaint the secretary of the E.D.A. with any new devices and developments in their branch of industry, so that the public may be kept alive to the best and latest practice in electrical science. Direct advertising on behalf of individual members does not form any part of the functions of the E.D.A.

The report contains particulars of additions made to the BEAMA list of publications during the year.

The standing rule of the Association which barred members from incurring the expense of exhibiting at shows not sanctioned by the Council, came under consideration during 1920 in response to representations by certain northern members that they suffered hardship under its operation. The rule was, after due consideration, modified so as to apply to electrical exhibitions only, and the modified suspension dates so as to terminate on December 31st, 1921. It follows that all members are free to accept an invitation to exhibit at any exhibition which is not wholly or mainly electrical until that date without the sanction of the Council. Owing to difficulties in obtaining the required space, a date has not yet been settled for the holding of the next BEAMA exhibition.

The Council regard the holding of an annual dinner by the Association as a matter of expediency to which no element of indispensability necessarily attaches; and, after consideration of the general situation, have decided that it may very well be dispensed with this year.

"Thanks to the liberality of members, your Association's subscription list is in a very satisfactory state. The increase of the maximum subscription (from £250 to £500) decided upon in 1919, was found inadequate to meet the increased expenditure, and your Council last year again raised the maximum subscription (from £500 to £1,000), and altered the rate of assessed subscriptions from 2s. 6d. per cent. of wages paid to 5s. per cent., the minimum (£10) remaining as before. The new rates came into force on October 1st, 1920, and the manner in which members have met the call, and the fact that several members liable in the minimum subscription only have voluntarily doubled it, are excellent testimony to their appreciation of the work accomplished by your Association."

The Council announce the creation of a fund (*a*) to meet applications for financial support from other organisations in the electrical and allied industries engaged in a mutual effort to develop them in all branches in the United Kingdom; (*b*) to assist, in particular, the Electrical Development Association in its work; and (*c*) to support financially the Electrical Research Association and the British Engineering Standards Association. This electrical and allied industries development fund is under the control of a financial board representing the contributing sections who act in co-operation with the Council.

An instrument transformer section was constituted during the year, and has made a promising start.

The Association maintains close working relations with the Institution of Electrical Engineers and other bodies.

The system of tendering embodied in the cross-tendering agreements continues to find favour among members, but has not been extended.

The number of members on the register of your Association at the end of the year was 224. Fourteen members were admitted to membership during that period and 15 resigned, due in many cases to amalgamation, reconstruction, or dissolution.

EXCITATION AND FIELD TEMPERATURE INDICATORS.

Two New Electrical Instruments.

The development of electric ship propulsion has emphasised the need for some new electrical instruments, two of which have been developed and are in use on the U.S.S. *New Mexico*, S.S. *Eclipse*, and the S.S. *Cuba*; they are known as excitation and field-temperature indicators, and are described in the February, 1921, issue of the *General Electric Review*, from which we abstract the following details and illustrations.

The *excitation indicator* shows the operator when the correct value of the alternator-field excitation is being maintained and whether it must be raised or lowered. It also indicates whether the motor and alternator are operating on the stable or unstable side of their combined characteristics, *i.e.*, whether the motor is "in or out of step" with the alternator, and the instrument can be used regardless of whether the motor is an induction or synchronous machine; in the latter case, however, the motor-field excitation should be varied together with the alternator field so as not to change the line power factor.

Fig. 1 shows the connections of the indicator to the lines between the alternator and the motor. There are current and potential elements, the vanes of the two elements being connected to a common movable shaft in such a way that when the stationary coils are excited, the torques produced in the vanes are opposite. Since there is no spring acting on the moving parts, the position taken by the shaft to which the pointer is attached depends only on the ratio of currents in the stationary coils of the two elements. The current element is connected directly to a current transformer in the line between alternator and motor. The potential element is connected in series with a high reactance x and then to a potential transformer as shown in fig. 1. Thus the current in the potential coil is directly proportional to line voltage, and on account of the reactance x it is inversely proportional to the frequency of the line voltage. Therefore, the position of the pointer depends on line voltage divided by line amperes and line frequency.

As a rule there is little saturation in an alternator when it is loaded up to maximum output with any value of field excitation that can be maintained continuously, since due to the regulation the line voltage will be below normal. If the line current, power-factor, and excitation are kept constant, then the line voltage and kilowatts output will vary directly as the frequency, from which it follows that the above-mentioned ratio is constant when the alternator is loaded up to maximum kilowatts output at a given power-factor regardless of what the speed of the alternator or its field excitation may be, it being understood that the field excitation is not higher than can be maintained continuously.

Therefore, since the position of the pointer of the excitation indicator depends on the same fraction, this position is always the same when the alternator is operating at its maximum kilowatts output regardless of excitation or speed. If at a constant load the alternator is operating at its maximum output and if the field excitation is then increased, the line voltage will increase and the line amperes will decrease causing the excitation indicator pointer to move; while if the field excitation is decreased, the indicator pointer will move

in the opposite direction. Thus the position of the pointer indicates whether the alternator is operating on the maximum of its output curve, whether it is on the stable side, or whether it is on the unstable side, that is, on the side where an increase in line current gives a decrease in kilowatts. This decrease in kilowatts output is due to the fact that the voltage decreases at a greater rate than the current increases.

In the case of electric ship propulsion equipment, the alternator cannot hold the driving motor in step when operating on the unstable side of its output curve regardless of whether the motor is an induction or a synchronous motor, and if the motor is out of step it will pull the alternator over on the unstable side. Therefore, when the pointer of the excitation indicator shows that the alternator is operated on the unstable part of its characteristic, the motor is out of step and should be brought into step.

To run at the highest economy and with least heating of the alternator field, the alternator-field excitation should be kept as low as will hold the motor in step; in other words, the alternator should operate as near the maximum of its output characteristic as the variations in propeller load will allow.

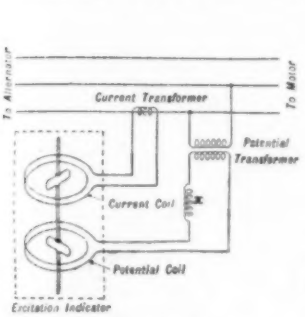


Fig. 1.—Excitation Indicator.

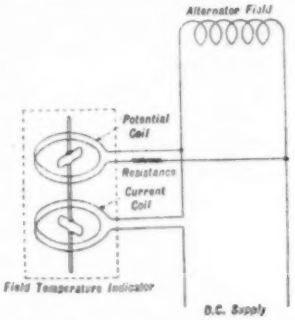


Fig. 2.—A.c. Generator Field Temperature Indicator.

The instrument cannot be taken from one equipment and be connected to another equipment of different design without changes and recalibration.

The *field-temperature indicator* depends for its operation on the change in resistance of a conductor with change in its temperature. It really indicates electrical resistance, but instead of a scale of resistance a scale of temperature in degrees Fahrenheit is used, and is employed on the alternator field only, no such instrument being necessary on the field of the synchronous motor.

The connections to the alternator-field circuit are shown in fig. 2, from which it will be seen that it is similar to the excitation indicator. When the two stationary coils are excited, the torques produced in the vanes are in opposite directions, and the resultant position taken by the shaft, to which a pointer is attached, depends only on the ratio of the currents in the two stationary coils; or since one coil is connected across and the other in series with the field, it depends on the ratio of the voltage applied to the field to the current in the field. Since there is a definite relation between the resistance of a copper conductor and its temperature, the instrument is calibrated directly for temperature, and has to be calibrated for the field to which it is to be connected and cannot be used on another alternator without recalibration.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Water-tube Boilers.

With reference to the article on Water-tube Boilers, by Mr. J. Cauthery, in the Electrical Review dated April 1st, this certainly contains very valuable advice with regard to the care of this type of boiler, and it evidently gives the results of many years' practical experience.

One correction, however, is necessary under the heading "Causes," section (*d*), which reads: "Excessive density where the water in boiler contains material proportion of salts or other matter in *suspension*."

This should read "in *solution*," and not suspension. Matter in suspension has, of course, no effect whatever on the density of water.

As regards Mr. Cauthery's limit of boiler water density, which he gives as 2/32nds, we do not think many engineers who have the control of water-tube boilers would go anywhere near this figure. Boiler insurance companies usually recommend a maximum of one-half of 1/32nd with this type of boiler, and we consider that this should be the limit; otherwise priming, overheating, and other troubles soon develop. Our experience is that for modern high-pressure water-tube boilers, the density is seldom allowed to exceed one-quarter of a 1/32nd, and when it does rise above this, it usually indicates a leaky condenser. It would be interesting to have the experience of engineers in charge of water-tube boilers at electricity stations in this respect.

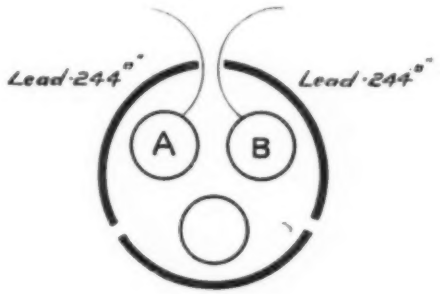
per pro **Porter Water Softening & Eng. Co.**
W. H. Porter.

Flixton, Manchester.
April 4th, 1921.

Heating of Buried Cables Report.

I have read with interest Major Taylor's letter in your issue of the 1st inst., and can only say that the results appear to me extraordinary. So far as I know they are entirely at variance with all previous experiments on the same subject and with the Buried Cables Preliminary Report, which distinctly states that tests were made both with alternating current at 50 cycles and with direct current, and there was no appreciable difference in heating.

Suppose we consider a 0.15 sq. in. 20,000-V cable carrying 230 amps. in each core; a 120 deg. sector of lead on this cable would be about 0.244 sq. in., so that the current required in



this sector to equal 62½ per cent. of the corresponding core loss would be 29 per cent. of the core current = 67 amps., which does not seem reasonable.

Again, suppose we make a perfect transformer between two cores and two lead sectors as per sketch, then all the flux generated by cores A and B will interlink the sectors so that mutual inductance will be equal to the self-inductance of the cores. This works out to roughly 1 millihenry per mile, and at 230 amps. the voltage induced in the secondary will be $2\pi 25 \times 230/1{,}000 = 36.1$.

The resistance of the secondary is about 4 ohms per mile, so that, neglecting reactance, the induced current would be about 9 amps. under ideal conditions instead of 67.

The above figures are only rough, and are based on the temperature rises given in Major Taylor's remarks published in the Review of December 31st.

With regard to eddy-current losses in the lead sheaths of single-conductor unarmoured cables, Messrs. Clark and Shanklin, in their paper on "High-tension Single-conductor Cable of Polyphase Systems" summarised their results, one of which is given as follows:—

"By testing lengths of lead-sheathed cable and then repeating the measurement after the sheath was removed, it was clearly proved that the additional loss due to eddy currents in the open-circuited sheath was too small to be detected."

It is to be hoped that Major Taylor will publish details of the cable used for his tests and his methods of making these experiments.

J. A. Morton.

Prescot.
April 4th, 1921.

Mr. J. A. Morton has very kindly allowed me to see his letter to you of the 4th inst., before publication, and though I cannot at the moment reply fully, yet perhaps misinterpretation of my letter by your readers may be avoided if I state very briefly the points which have, I believe, been demonstrated by the experiments referred to.

First, let me say with reference to Mr. Morton's quotation from Messrs. Clark and Shanklin's paper that I agree that in the case of unarmoured single-phase cables the increased loss over that of direct current is inconsiderable. I regret, also, that in my letter published in your issue of the 1st inst., I inadvertently quoted Monsieur Capelville's results as supporting my own figures. These results, at the time of writing, I took to be made with cables having wire armouring, which greatly affects the results. Moreover, they refer only to single phase currents.

The point I wish to make is that, assuming there is nothing demonstratively wrong in the tests which I have been permitted to put forward, the loss in a 3-core armoured cable, due to the *rotating* field produced by the polyphase current as distinct from the loss due to the *pulsating* field in each individual conductor, is some 50 per cent. above the rise due to a uniformly distributed continuous current, when tested at 25 periods, and is considerably less when tested at 50

periods. If, however, the cable is stripped of its armour, the losses are greater in each case (25 and 50 periods), but are still considerably less with 50 periods than with 25 periods.

It is, no doubt, very difficult to separate the loss due to the rotating field from that due to the pulsation of the current, but the fact that with 3-phase currents the losses in unarmoured cables are in each case considerably greater than those in armoured cables, coupled with the fact that with single-phase currents in the same cables the losses in armoured cables—particularly at 50 periods—are enormously greater than in unarmoured cables, proves to my mind conclusively that the first-mentioned (*i.e.*, the loss with 3-phase currents) is a loss caused by the *rotating* field, while the second mentioned (*i.e.*, the loss due to single-phase currents) is a loss due to the *pulsating* field.

The above assumption of the loss due to the rotating field is, I think, further borne out by the fact of the losses due to this cause being considerably less at 50 periods than at 25 periods. If we think of the lead sheathing as being a closed secondary circuit, and consider, for example, that in the case of 25 periods a magnet having a given strength is rotated inside that closed circuit, there will be a certain reduction of the field due to that magnet by the reaction of the 25-period eddy currents induced in the lead sheathing. If, now, we rotate a magnet of exactly equal strength at double the speed, the eddy currents would tend—for unreduced field—to cancel the flux due to the magnet with double the force that they did in the first case, and the resultant of the action and reaction would be a considerably reduced field with consequently reduced loss. If the speed of rotation were infinite there would be no field at all, and no loss.

The fact that, with an armoured cable and with three-phase currents, the loss is *less than with an unarmoured cable* can, I think, be explained on the assumption that when there is no armouring the rotating field is more or less concentrated on a diameter of the cable, and that the lines of flux pass through the lead sheathing normal to the surface of the same, whereas, when there is a steel wire armouring, two parallel magnetic return paths are formed, closely contiguous to the copper cores, and the lines of flux no longer enter the lead sheathing normal to the surface, but they branch away from the diametral line in both directions, and pass through the lead sheathing at quite an easy slope, corresponding more nearly to that which obtains when a single-phase pulsation takes place from a centrally situated core.

I regret that at this time I cannot give details of any of the tests, as to do so would be to take up too much of your valuable space, and would interfere with other work which I am engaged upon, but I hope later to be in a position to contribute these tests to the Institution files.

The whole of the argument in Mr. Morton's letter is on the basis of proving that the losses due to single-phase currents with unarmoured cables at 25 periods are negligible, and as I am virtually in agreement with him on this point, I will not attempt to controvert his arguments. I may say that when the "Buried Cables Report" came out I compared one or two observations with the figures which I possessed, and that where the buried cables were not tested in ducts, but in the open, the results seemed to agree pretty closely. I have not, however, looked again at these lately, but will do so at an early date.

A. M. Taylor,
Hon. Major, S.O.2., W.B.A.M.

Birmingham.
April 6th, 1921.

Power Installations.

With reference to the inquiry by "Interested," on page 379, in the Electrical Review dated March 25th, 1921, I would recommend "Machinery's Handbook," price 28s., obtainable from the Machinery Publishing Co., Ltd., 52, Chancery Lane, W.C. 2.

This gives the h.p. required for most kinds of machine tools, &c., and the types of motors used, from data collected by the Westinghouse Electric & Manufacturing Co., as well as a number of formulæ which are used in general practice.

Alec. Kur.

South Tankerton.
April 6th, 1921.

[We may add that similar data are given in "Electricity for Everybody," by R. Borlase Matthews, Electrical Press, Ltd., price 5s. net, and "Electricity in Factories and Workshops," by A. P. Haslam, Crosby Lockwood, price 7s. 6d. net. —Eds. Elec. Rev.]

Payment According to Ability.

Referring to "Broad Minded's" letter in your current issue, one is tempted to wonder whether the word "experience" counts at all. In the first place, do all people agree that 50 per cent. of new ideas, &c., emanate from the technical colleges? I do not wish to run down colleges, having a high opinion of the training I have received through them, but in my brief experience I have found that practice makes perfect. It is impossible for a man to be as experienced at 21 years of age as a man at 40, given equal intelligence. Indeed, according to the view of "Broad Minded," a man is better without any practical experience gained during ordinary work, than a man who has devoted years of study, &c., in negotiating difficulties met with in the course of his work, which argument will not hold water. Why do all chiefs of firms advertise for men of experience if younger men without any would do? Regarding the statement "If there was a little less cant amongst British workmen," I fail to see its application. I have had charge of plenty of "British workmen," and consider them very good material to help build up our "old country."

In conclusion, I quite agree that everyone requires a living, but would also add that everyone must start at the bottom of the ladder.

Experience.

April 9th, 1921.

Your correspondent "A Regular Reader" seems to have missed the point in my question: "Who was the better man?" He admits that I was; yet my first employer evidently thought differently, and under such a scheme as "A Regular Reader" suggests would have paid me less than the other man. He further states that he does not care whether a man is married and has children or not. Just so; he would treat him as a mere machine for producing profits. This attitude on the part of a section of employers, backed by such men as "A Regular Reader," is responsible to a great extent for the prevailing industrial discontent and the spread of such pernicious doctrines as Bolshevism and Communism. He further states that I failed to pass my test through want of experience. Yes, I grant that, though not through lack of ability, as I think I proved. He, however, says: "Payment according to ability." Ability and experience are not synonymous terms.

To put "fear of unemployment" down as utter nonsense is a very convenient way of disposing of the argument, but it is a very real cause of low production, as any electrical contractor knows to his cost when trade is slack. A man can do his work quickly and well, but there is a limit beyond which he can only increase quantity at the expense of quality. A foreman or manager may, though not invariably, know who is his best man, but may not recognise the fact. His best man may be an even better man than himself, in which case jealousy, mutual or otherwise, would probably take a part. The best workman as regards skill and output per hour may be the most unreliable timekeeper. The best man is more likely to resent criticism, thereby putting himself out of favour. Then there is a grievance in many a shop over the foreman's relatives. Lots of influences are at work besides a man's efficiency. One has to deal with things as they are, not as they should be. Your correspondent seems to think he has to deal with machines instead of men. He should have stated "Payment by results" instead of "Payment according to ability." Payment by results would undoubtedly increase production, but the majority of workmen object to it. Why? Simply because experience has taught them that when earnings have reached a high level employers have attempted, sometimes successfully, to cut rates, even though the proportion of standing charges to unit of output has gone in their favour. The result is that the men have lost confidence in their employers. Restore that confidence and we shall be well on the way to higher production, whether payment be by results or by time.

Another Regular Reader.

April 11th, 1921.

A Peculiar Phenomenon.

I am very interested in a letter entitled "A Peculiar Phenomenon" in your current issue, which deals with the luminous blue-grey glow caused when fingering a small dry metal-filament bulb. I have recently noticed this in connection with a 4-volt m.f. lamp, and shall be glad if some other reader can give some elucidation.

F. Ainsley Cook.

Newcastle-on-Tyne.
April 9th, 1921.

Wiring Ferro-concrete Factories.

One would have thought that the object that "Phase" and myself had in view when writing our letters had been sufficiently explained and endorsed by the Editors' note on the "Freedom of the Press" in the issue of the 1st inst.

Cannot "Two Phase" understand that if Mr. Brooking had written courteously explaining to what extent C.T.S. *was* suitable for use in ferro-concrete factories, we should all have been obliged to him, and still more so if this were supported by the recommendations of unbiased users, of whom I presume "Two Phase" to be one?

The difference between the *possibility* of using a certain system in a particular case and the fact of its being the most *suitable* does not seem to be properly appreciated by Mr. Brooking or "Two Phase."

The choice of a system of wiring for particular circumstances must be a matter for the judgment of those concerned, and it is exceedingly improbable that any one system will be the most suitable for every case.

In the particular industry in which I am engaged, one in which there is considerable fire risk, I am so far convinced that V.I.R. wire in heavy gauge weldless screwed conduit is the safest system, and in certain districts the use of this sys-

tem is laid down as a condition for passing buildings (electrically lighted) for this purpose.

The exponents of C.T.S. should remember that they virtually relegate all other systems to the scrap heap, and consequently should be prepared for a little criticism themselves.

Now, I think our good Editors will agree that it is time we got back to the original subject of this correspondence—viz., the best form of wiring for ferro-concrete factories, and gave our original "Inquirer" the fair play which "Two Phase" quite rightly holds so dear.

A. C. Purday.

Croydon.
April 11th, 1921.

As the contractor for the 250 houses mentioned in this correspondence, I would like to say something about my experience with regard to C.T.S.

At first, I admit, I did not jump at it, as I never like risking my reputation on a comparatively new and at that time unproved system. I was, however, forced into using it for a fairly big job, because C.T.S. was specified, and I then found out some of its advantages, namely, ease of erection and fewness of tools required.

One of your correspondents asks what C.T.S. is unsuitable for. At one time I should have put a fairly long list forward with regard to this, but now I find it difficult to think of anything, in view of the large number of varied conditions under which I have used it.

I do not think it would be commercially suitable for underground mains.

I, however, look forward to learning of any defects, as my experience of C.T.S. may be limited compared with the experience of others.

per pro **Harry Rogers.**
J. B. Robertson.

Warrington.
April 11th, 1921.

Your correspondents all seem to strike the wrong note, and Mr. Brooking, although quite right in his threat *re* legal proceedings, would have made his point much better if instead he had emphasised the fact that the correspondent did not know the subject he was writing about. We hold no brief for C.T.S. cable, with the exception that we have used a great deal of this cable on all sorts and conditions of installations and have never yet found it fail to do all that is claimed for it. We are sorry and can quite feel for Mr. Brooking, for *we* have had to put up with a lot of semi-libellous statements *re* C.T.S. cable from people who should know better. Most of it is prejudice—for we are a very conservative nation as regards new applications—and a manufacturer has no guarantee that in open column discussions a "stick-in-the-mud," ignorant of the matter at issue, will not rush into print and undo a lot of good work. It is really a dangerous precedent, Mr. Editor, to allow your columns to be used at all for or against any particular manufacturer's commodity. If in favour, it looks like a cheap "puff"; if against, it may be libellous, or at any rate, unfair. We, like "Two Phase," would like to know what job it is not suitable for. We have installed it in laundries with their excesses of water and steam, boiler houses with tremendous heat, and refrigerators with the opposite of temperature, and yet no complaints. Has our friend—who has so much against C.T.S.—tried it under all these circumstances? If so, will he let us know where it fails? If not, will he stop rushing into print *re* something he knows nothing about, for "a little knowledge is a dangerous thing."

Hurlingham Electric Co.
Fred. C. Ferrier.

London.
April 4th, 1921.

[The correspondence on this subject has proved very interesting, and has amply demonstrated the accuracy of our statement of April 1st (p. 402): "If the subject under discussion is meritorious, the fact is sure to be brought out." Mr. Brooking could not have wished for a finer series of tributes to the merits of his system than it has received. Incidentally, we may point out, as some of our correspondents do not seem to have read "Inquirer's" letter, that he did not make any attack upon C.T.S. wire, which he regarded as "ideal for some classes of work." The question under discussion is specifically the best method of wiring *ferro-concrete factories*, and it is a question of considerable importance.—Eds. Elec. Rev.]

Third Harmonics.

Referring to Mr. J. B. Stansfield's letter of the 24th ult., I quite agree that the e.m.f. wave corresponding to a smooth flux wave will not possess ripples provided it is shown as embodying *all* the harmonics involved.

The e.m.f. waves shown in figs. 5 and 6 were obtained by analysis and differentiation of the flux wave, and when actually completing the e.m.f. wave, harmonics above the fifth were ignored. This accounts for the rippling of the e.m.f. wave at the zero axis.

If Mr. Stansfield's letter is an indication of interest in the article I shall be pleased to send him a reprint copy on receipt of his address.

S. Austen Stigant.

Lewisham.
April 5th, 1921.

Conditions of Living and Prospects in Brazil.

Having noticed from time to time in your valued columns inquiries relative to conditions abroad, and also noting that many of your readers with foreign experience were obliging enough to give help in this way, I wonder if, through the medium of your paper, I could obtain information as to the climate from a Britisher's point of view, and the outlook of the electrical industry in Brazil; particularly in the State of Sao Paulo. Any little knowledge gleaned will be gratefully accepted.

Inquirer.

April 5th, 1921.

[A series of articles on Brazilian conditions appeared in the Electrical Review commencing November 10th, 1911, which dealt very fully with the position at that time. The climate is quite suitable for British immigrants (but what climate is not?). We shall be pleased to receive communications on the subject.—Eds. Elec. Rev.]

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR MARCH, 1921.

The trade figures for March followed very closely those of the previous month. Export and import figures showed increases of about 3·7 per cent., and 5·7 per cent. respectively, while re-exports were reduced by approximately 2·3 per cent. In the exports section there were increases in the shipping of electrical goods and apparatus (unenumerated), insulated wire, glow lamps, meters, electrical machinery (unenumerated), switchboards, and telegraph and telephone instruments and apparatus; other export items showed reductions, especially arc lamps, which fell from £2,421 to £467. Increases occurred in the value of imports of unenumerated electrical goods, insulated wire, batteries, unenumerated electrical machinery, and telegraph and telephone instruments and apparatus. The re-export of meters experienced a considerable decline, but the value of re-exported telegraph and telephone instruments was doubled.

Values of Electrical Exports and Imports for March, 1921.

	Exports.	Imports.	Re-exports
Electrical goods and apparatus (unenumerated)	£234,722	£94,969	£15,447
Insulated wire	382,804	20,754	525
Glow lamps	49,503	21,302	11,552
Arc lamps and parts	467	1,452	27
Batteries	57,518	20,215	—
Meters	36,119	26,114	593
Carbons	9,532	4,645	86
Electrical machinery:—			
Railway and tramway motors ...	8,949	—	—
Other motors and generators ...	229,243	—	—
Electrical machinery (unenumerated)	178,961	71,853	2,144
Switchboards (not telegraph or telephone)	14,146	—	20
Telegraph and telephone cable and material:—			
Telegraph and telephone wire and cable (not submarine)	131,140	2,219	184
Submarine telegraph and telephone cable	86,682	—	—
Telegraph and telephone instruments and apparatus	153,085	33,739	1,890
Totals... ...	£1,572,871	£297,262	£32,468

Preventing Insulator Breakage.—Writing in the *Electrical World*, Mr. R. H. W. Lockyer, of Trail, B.C., says:—A sliding base to allow for the expansion of heavy 'buses has put an end to a considerable breakage of post-type insulators that had been customary in a Canadian power company's station. A heavy bus-bar of some length and supported rigidly on post-type insulators was giving trouble because of the tendency of the insulators to break off. Upon investigation it was found this was due to the expansion of the 'bus when operating heavily loaded. Many remedial schemes were thought of—such as expansion joints in the 'bus—but no other was so effective as a post-type insulator on a sliding base. The base consists of two separate parts, one the brass slipper which is attached to the insulator and the other the guide in which the slipper moves. The guide is of machined grey cast-iron. When the 'bus changes its length no strain is put on the insulator, as it is free to slide with the 'bus.

NEW PATENTS APPLIED FOR, 1921.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

9,216. "Electric light extension switch." R. Amy and E. F. Greenshields. March 29th.
9,242. "Electrical distribution fuse-boards, fuse-boxes, &c." W. G. H. Cox, Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. March 29th.
9,270. "Movable point for overhead run-ways." H. Morley and W. Tout. March 29th.
9,294. "Electric switches." J. Murray. March 29th.
9,318. "Automatic electric heating device for glass furnaces." L. N. Bruner and W. G. Clark. March 29th. (United States, March 29th, 1920.)
9,322. "Electric dry battery cells." A. Aron. March 29th. (Germany, March 29th, 1920.)
9,332. "Dipping tanks for electrical apparatus, &c." H. D. Symons. March 29th.
9,366. "Control of electric motors." R. Brooks, S. Gowan and Metropolitan-Vickers Electrical Co., Ltd. March 29th.
9,368. "Fusible electric cut-outs." L. Bartmann. March 29th.
9,385. "Devices for transforming electrical energy into mechanical energy and inversely." J. E. A. Michel. March 29th.
9,388. "Electric switches, &c." Firm of A. Cohn, Snr. March 29th. (Germany, April 23rd, 1919.)
9,406. "Telephoto lenses." O. E. Wheeler. March 30th.
9,411. "Speed regulating devices for electric motors." L. T. Bates. March 30th.
9,465. "Electrically illuminated signs." J. Moiseiwitsch. March 30th.
9,470. "Wireless telegraph transmitters." Ges. für Drahtlose Telegraphie. March 30th. (Germany, March 31st, 1920.)
9,471. "Telephone systems." Ges. für Drahtlose Telegraphie. March 30th. (Germany, April 1st, 1920.)
9,473. "Speed regulating systems." British Thomson-Houston Co., Ltd. (General Electric Co.). March 30th.
9,475. "Repair of metallic lamp filaments." J. von Rottenburg. March 30th. (Germany, August 24th, 1920.)
9,490. "Automatic circuit breaker, &c." E. C. R. Marks (Elektriska Aktiebolaget Volta). March 30th.
9,491. "Electric drive." E. C. R. Marks (Soc. Anon. Construction Electriques de Belgique). March 30th.
9,494. "Storage batteries." H. E. Smith. March 30th. (United States, March 31st, 1920.)
9,498. "Apparatus to be connected to telephones to deliver a message." C. J. Maglekilde-Petersen. March 30th. (Denmark, March 31st, 1920.)
9,501. "Means for detecting breaks, &c., in submarine electric cables." B. S. Smith and F. B. Young. March 30th.
9,507. "Apparatus for examining X-ray tubes, &c." G. Hübers. March 30th.
9,518. "Automatic, &c., telephone systems." W. D. Edwards and Relay Automatic Telephone Co., Ltd. March 30th.
9,522. "Electric controllers." L. Satchwell. March 30th.
9,524. "Electric switches." E. Dobson and Foster Engineering Co., Ltd. March 30th.
9,529. "Switch wall plug." A. N. Gosling. March 31st.
9,532. "Control systems for electric furnaces." O. G. Sharples. March 31st.
9,536. "Continuous current electrical systems." J. A. M. V. de P. Givelet. March 31st.
9,552. "Wireless telephony." R. Whiddington. March 31st.
9,553. "Reciprocating electric motors." A. Bettica, A. Macchioni, and G. Mazza. March 31st.
9,558. "Copper contact plates for controllers for electrically-propelled vehicles." W. Scott. March 31st.
9,590. "Electrical resistance grids." R. F. Baerlocher. March 31st.
9,591. "Commutators for dynamo electric machines." R. F. Baerlocher. March 31st.
9,593. "Combined dynamo and motor." W. H. Robinson. March 31st.
9,595. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. March 31st.
9,596. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co., Ltd. March 31st.
9,598. "Accumulators for motor cars, &c." W. T. Coulson. March 31st.
9,599. "Automatic circuit interrupting apparatus." G. A. Cheetham and Metropolitan-Vickers Electrical Co., Ltd. March 31st.
9,604. "Sockets or bases of trolley poles for electrically propelled vehicles." E. M. Munro. March 31st.
9,607. "Dry cell for electric pocket lamps." J. Skorpik. March 31st. (Germany, March 25th, 1919.)
9,618. "Magnetic separators." S. Percival (Central Mining and Investment Corporation, Ltd., Transvaal, Consolidated Land & Exploration Co., Ltd., S. T. Tregaskis, and L. B. Woodworth). March 31st.
9,628. "Processing higher harmonic currents in secondary circuit of polyphase metal-vapour rectifiers." Akt.-Ges. Brown, Boveri et Cie. March 31st. (Switzerland, April 1st, 1920.)
9,654. "Means for recording and gauging duration of telephone calls." J. Dunlop. March 31st.
9,657. "Circuit making and breaking device." E. Schattner. March 31st.
9,664. "Call recording device for telephone instruments." R. B. Dunlop. April 1st.
9,693. "Self-cleaning sparking plug." D. D. Esson. April 1st.
9,707. "Spring contacts of electric lamps." J. H. Brown. April 1st.
9,721. "Electric heaters." Cutler-Hammer Manufacturing Co. April 1st. (United States, June 22nd, 1920.)
9,724. "Dynamo electric machines." W. E. M. Ayres. April 1st.
9,741. "Automatic electric switches." H. W. F. Ireland, H. Lucas, and O. Lucas. April 1st.
9,742. "Electro-magnetic horns." H. W. F. Ireland, H. Lucas, and O. Lucas. April 1st.
9,752. "Thermionic valves, &c." Mullard Radio Valve Co., Ltd., and S. R. Mullard. April 1st.
9,754. "Fittings for electrical conduits." A. F. Smith. April 1st.
9,763. "Switches of the quick make and break type." J. B. Tucker. April 2nd.
9,771. "Method of fixing in place stator cores of induction motors, &c." Electric Construction Co., Ltd., and H. Jones. April 2nd.
9,774. "Electrical indicator and controller for bearings." G. Marshman. April 2nd.
9,779. "Sealing ends of cable-carrying pipes." H. R. Billing. April 2nd.
9,792. "Automatically indicating location of fault or overload in electric power system." J. S. Blackhall. April 2nd.
9,805. "Electric, &c., lighting apparatus" W. L. Chance and F. E. Lamplough. April 2nd.
9,807. "Search lights, &c." F. Simoni. April 2nd.
9,814. "Electric fuse boxes." H. A. Erdbrink, F. C. Mellmann, and F. W. Randt. April 2nd.
9,823. "Means for controlling power factor of motor, &c., circuits." H. A. Carney. April 2nd.
9,825. "Electrically-operated bells, &c." J. H. Henderson, F. V. Russell, W. K. Sykes, Interlocking Signal Co., Ltd., and E. S. Tiddeman. April 2nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

2,158. "Continuous current measuring apparatus with iron in the field of current." Allgemeine Elektricitats Gesellschaft. February 13th, 1917. (Germany, June 24th, 1914.) (10,480.)

1918.

5,398. "Process of electrolytically producing iron and alloys thereof." A. T. C. Estelle. March 27th, 1918. (159,906.)

1919.

11,303. "Electrically heated soldering irons." Soc. Anon. Dite "Calor." May 6th, 1918. (126,635.)
15,317. "Electric irons." G. A. Hughes. June 18th, 1919. (159,909.)
18,148. "Electric ovens." F. T. Hewson. January 20th, 1920. (160,191.)
21,446. "Electric fuses, heating elements, and the like." A. F. Berry. September 1st, 1919. (160,195.)
21,891. "Electric wave form indicators or oscillographs." P. Trichard. September 5th, 1919. (160,196.)
22,287. "Electric supply systems." F. Mouron. September 10th, 1919. (Switzerland, September 10th, 1918.) (132,516.)
24,683. "Electrical testing apparatus." R. H. Lane and Indicators, Ltd. October 9th, 1919. (160,201.)
25,440. "Electric clocks." I. H. Parsons and A. E. J. Ball. October 17th, 1919. (160,204.)
26,415. "Electrical cut-out." W. H. Illingworth. October 28th, 1919. (Cognate application 14,414/20.) (159,917.)
26,984. "Means for supporting electric fittings from conduit outlet boxes and the like." E. C. R. Marks (Toledo Metal Products Co.). November 3rd, 1919. (159,918.)
27,314. "Construction of vacuum tubes and the like, especially of the type used in wireless communication." J. Scott-Taggart. November 6th, 1919. (159,920.)
27,324. "Electric driving and controlling gear for planing machines." Electromotors, Ltd., H. Longbottom, and E. Greenhalgh. November 6th, 1919. (160,209.)
27,636. "Ammeters, voltmeters, and other recording and indicating instruments." W. F. Smith and T. G. P. Healey. November 4th, 1919. (160,211.)
27,706. "Suspension chains for the support of electric lamps, lamp fittings, and electric cables and wires, and other purposes." J. I. Hall. November 10th, 1919. (159,932.)
27,938. "Dynamo-electric machines." A. E. White (United States Light and Heat Corporation). November 11th, 1919. (159,939.)
28,307. "Electric connections." British Electric Transformer Co., Ltd., and W. J. Sims. November 14th, 1919. (160,218.)
28,499. "Electric gas lamp with glow discharge." Pintsch Akt.-Ges. October 27th, 1917. (135,485.)
30,355. "Manufacture of thermionic valves and the like." H. L. Crowther and W. Makower. December 4th, 1919. (159,955.)
30,485. "Conducting leads for electrical apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 5th, 1919. (159,958.)
30,487. "Electro-magnetic wave signalling apparatus." J. Robinson and H. L. Crowther. December 5th, 1919. (159,959.)
30,792. "Magneto electric machines." F. J. Lord and R. A. Taylor. December 9th, 1919. (159,975.)
30,800. "Signalling transmitting mechanisms." Western Electric Co., Ltd. (Western Electric Co., Inc.). December 9th, 1919. (Addition to 24,506/14.) (159,976.)
30,816. "Electric furnaces for calcining magnesia and for similar purposes." F. S. Newall. December 9th, 1919. (160,231.)
30,843. "Thermionic amplifiers and detectors." H. J. Round. December 9th, 1919. (159,984.)
31,088. "Electrical coils and the manufacture thereof." H. Wade (Coto-Coil Co.). December 11th, 1919. (159,997.)
31,268. "Telephones." R. L. Murray and Telephone Manufacturing Co., Ltd. December 13th, 1919. (160,243.)
31,304. "Electrical signalling apparatus for use in mines and other places." F. E. Imeson and C. Hunter. December 13th, 1919. (160,245.)
31,329. "Sparking plugs." F. J. Nicholls. December 15th, 1919. (160,001.)
31,345. "Radio-navigational apparatus and the like." J. Erskine-Murray, J. Robinson, and H. L. Crowther. December 15th, 1919. (160,250.)
31,346. "Radio-navigational apparatus and the like." J. Erskine-Murray, J. Robinson, and H. L. Crowther. December 15th, 1919. (160,251.)
31,384. "Electrically-driven sewing machines." F. W. Le Tall (Westinghouse Electric & Manufacturing Co.). December 15th, 1919. (160,255.)
31,390. "Electric lighting systems for automobiles and other vehicles." J. S. Withers (L. Renault). December 15th, 1919. (160,257.)
31,472. "Mounting of rotary shafts for electric motors, dynamos, and rotary converters." L. King. December 16th, 1919. (160,260.)
31,501. "Electric signalling apparatus." M. J. Railing and J. J. V. Connaughton." December 16th, 1919. (Addition to 139,994.) (160,261.)
31,891. "Contact breakers for ignition magnetos and the like." Villiers Engineering Co., Ltd., F. H. Farrer, and F. Bountney. December 19th, 1919. (160,283.)
31,966. "Sparking plugs for internal combustion engines." G. Wilson. December 20th, 1919. (160,011.)
32,090. "Protective devices for electric circuits." British Thomson-Houston Co., Ltd. (General Electric Co.). December 22nd, 1919. (160,017.)
32,194. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd, 1919. (160,019.)
32,195. "X-ray apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). December 23rd, 1919. (160,020.)
32,732. "Alternating current electric control mechanism for cranes or other hoisting gear." H. Morris, Ltd., and W. N. Weston. December 31st, 1919. (160,302.)
32,828. "Masts for boats, ships, aeroplanes, seaplanes, portable wireless installations, and other purposes." J. Harrison (legal personal representative of C. Harrison, deceased). December 31st, 1919. (160,027.)
32,881. "Apparatus for waving or curling the hair." Quain Electric Co., Ltd., and J. R. Spink. December 31st, 1919. (160,304.)

1920.

152. "Dynamo-electric machines." British Thomson-Houston Co., Ltd., H. W. Taylor, J. Hutt, and F. H. Clough. January 2nd, 1920. (160,307.)
243. "Electric insulators for electric switches and like connections." British Thomson-Houston Co., Ltd., and H. Trencham. January 3rd, 1920. (160,031.)
2,031. "Apparatus for grinding electric commutators or distributors." F. Bolton. January 22nd, 1920. (160,330.)
4,058. "Electrical heating apparatus." G. F. Joseph. February 10th, 1920. (160,348.)
5,024. "Electrical fuses, switches, and the like." Midland Electric Manufacturing Co., Ltd., and H. E. Sutherland. February 19th, 1920. (160,354.)
5,097. "Dynamos for use with lighting and starting devices upon motor vehicles." J. R. P. E. F. M. Grimaud. June 13th, 1919. (144,997.)
5,190. "Electric heaters for liquids." C. G. Nobbs and W. W. Nobbs. February 20th, 1920. (160,074.)
7,664. "Electric furnaces." E. C. R. Marks (Scovill Manufacturing Co.). March 15th, 1920. (160,082.)
8,878. "Electric signalling systems." Western Electric Co., Ltd. November 14th, 1914. (140,807.)

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608. "Means for cleaning cooling apparatus." K. Baumann and Metropolitan-Vickers Electrical Co., Ltd. October 27th, 1919. (Divided application on 158,060.) (160,134.)